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AYK REGION
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REPORT #30

ANVIK AND ANDREAFSKY RIVER SALMON STUDIES, 1986

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INTRODUCTION

The Anvik and Andreafsky Rivers are the two largest producers of summer chum salmon (Oncorhynchus keta) in the Yukon River drainage (Figure 1). Buklis (1982) estimated that the Anvik River alone accounts for 35% of the total production. Other known major spawning populations occur in the Rodo, Nulato, Gisasa, Hogatza, Melozitna, Tozitna, Chena, and Salcha Rivers. Summer chum salmon spawn in lesser numbers in other tributaries of the Yukon River. Chinook (O. tshawytscha) and pink (O. gorbuscha) salmon occur in the Anvik and Andreafsky Rivers coincidentally with summer chum salmon, while coho salmon (O. kisutch) are known to occur in small numbers in the fall, but their abundance is not monitored.

Commercial and subsistence fisheries that harvest Anvik and Andreafsky River summer chum salmon occur throughout the mainstem Yukon River from the coast of the delta to the mouths of the respective tributary streams. Set and drift gillnets are the legal fishing gear in Districts 1, 2, and 3, while set gillnets and fishwheels may be used in District 4. Most of the effort and harvest occurs in Districts 1 and 2, and in the lower portion of District 4, near the Anvik River. Fish taken commercially in the lower three districts are fresh frozen, while District 4 is a roe fishery due to market conditions and flesh quality. Commercial and subsistence summer chum salmon fisheries in the remainder of District 4 and in District 6 are supported by stocks other than those of the Andreafsky and Anvik Rivers. Very few summer chum salmon are harvested in District 5 due to the lack of significant spawning populations in that portion of the drainage. There are no scale pattern, electrophoretic, or mark-recapture stock identification data available on Yukon River summer chum salmon.

Chinook salmon are the target species of the lower Yukon River (Districts 1, 2, and 3) commercial fishery during June and early July. Fishing is usually permitted with unrestricted mesh size gillnets until changeover to 6 inch maximum mesh size is required by Emergency Order. In most years the majority of the summer chum salmon run has passed through the lower river districts before the changeover to chum salmon gear. As a result, most of the summer chum salmon commercial harvest in the lower Yukon is usually taken from the later portion of the run.

The Board of Fisheries directed that, beginning with the 1985 season, there may be special small mesh gear openningsduring the chinook salmon season to optimize harvest of summer chum salmon. This would require that a relatively large summer chum salmon run is in progress, and that the incidental harvest of chinook salmon would not be substantial enough to have an adverse effect on the management of that species. These criteria were judged to have been met in 1986, and special restricted (6" maximum) mesh size fishing periods were established in the lower river commercial

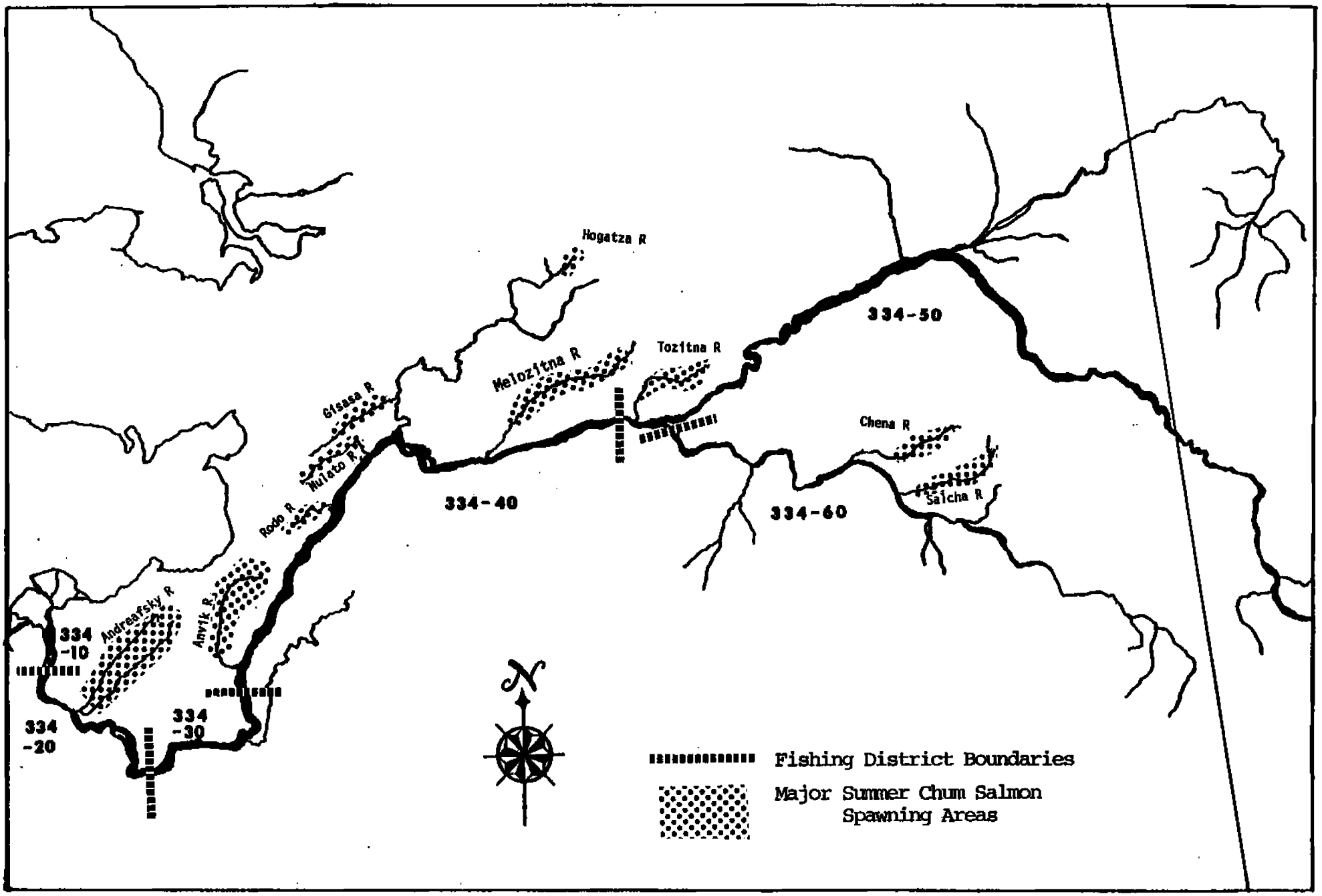


Figure 1. Map of the Yukon River, showing fishing districts and major summer chum salmon spawning areas.

fishery during the chinook salmon season. The District 4 commercial fishery is directed primarily at chum salmon. Subsistence fisheries in all four districts take summer chum salmon primarily for sled dog food.

Summer chum salmon escapements to the major spawning areas in the Yukon River drainage have been estimated by aerial survey from fixed wing aircraft on a consistent basis since the early 1970's. Aerial surveys are subject to error and variability due to weather and stream conditions, timing of the survey relative to spawning stage, and subjectivity and experience on the part of the observer. The counts obtained are only indices of abundance since not all salmon present on the day of the survey are usually seen, and earlier and later spawners are not present. However, these indices, if obtained under standardized conditions, can be used to monitor the relative abundance of spawning escapements. Aerial surveys are the most feasible method of assessing salmon escapements in terms of cost and staff limitations in a watershed as immense and remote as that of the Yukon River.

The Alaska Department of Fish and Game (ADF&G) has continued the aerial survey program while intensively studying a few important and representative tributary stream salmon spawning populations. The Anvik and Andreafsky Rivers have been chosen for summer chum salmon research studies. This report presents results of these studies for the 1986 field season, and provides recommendations for 1987 project operations.

ANVIK RIVER SALMON STUDY

The Anvik River (Figure 2) originates at an elevation of 1,300 feet and flows in a southerly direction approximately 120 miles to its mouth at mile 318 of the Yukon River. It is a narrow runoff stream with a substrate of gravel and cobble, except in the upper reach where bedrock is exposed. The Yellow River is a major tributary of the Anvik and is stained with tannic acid runoff. Downstream of the Yellow River confluence the Anvik River changes from a moderate gradient system to a low gradient system meandering through a much broader flood plain. Water clarity is reduced downstream of the Yellow River. Numerous oxbows, old channel cutoffs and sloughs are found throughout the lower river.

Salmon escapement was enumerated from counting towers located above the Yellow River from 1972 to 1978. A site 5-1/2 miles above the Yellow River was used from 1972 to 1975, and a site at Robinhood Creek, 2-1/2 miles above the Yellow River, was used from 1976 to 1978. Aerial surveys were flown each year (except 1974) in fixed-wing aircraft to estimate salmon abundance below the tower site. High and turbid water often affects the accuracy of visual salmon enumeration from counting towers and aircraft.

The Electrodynamics Division of the Bendix Corporation developed

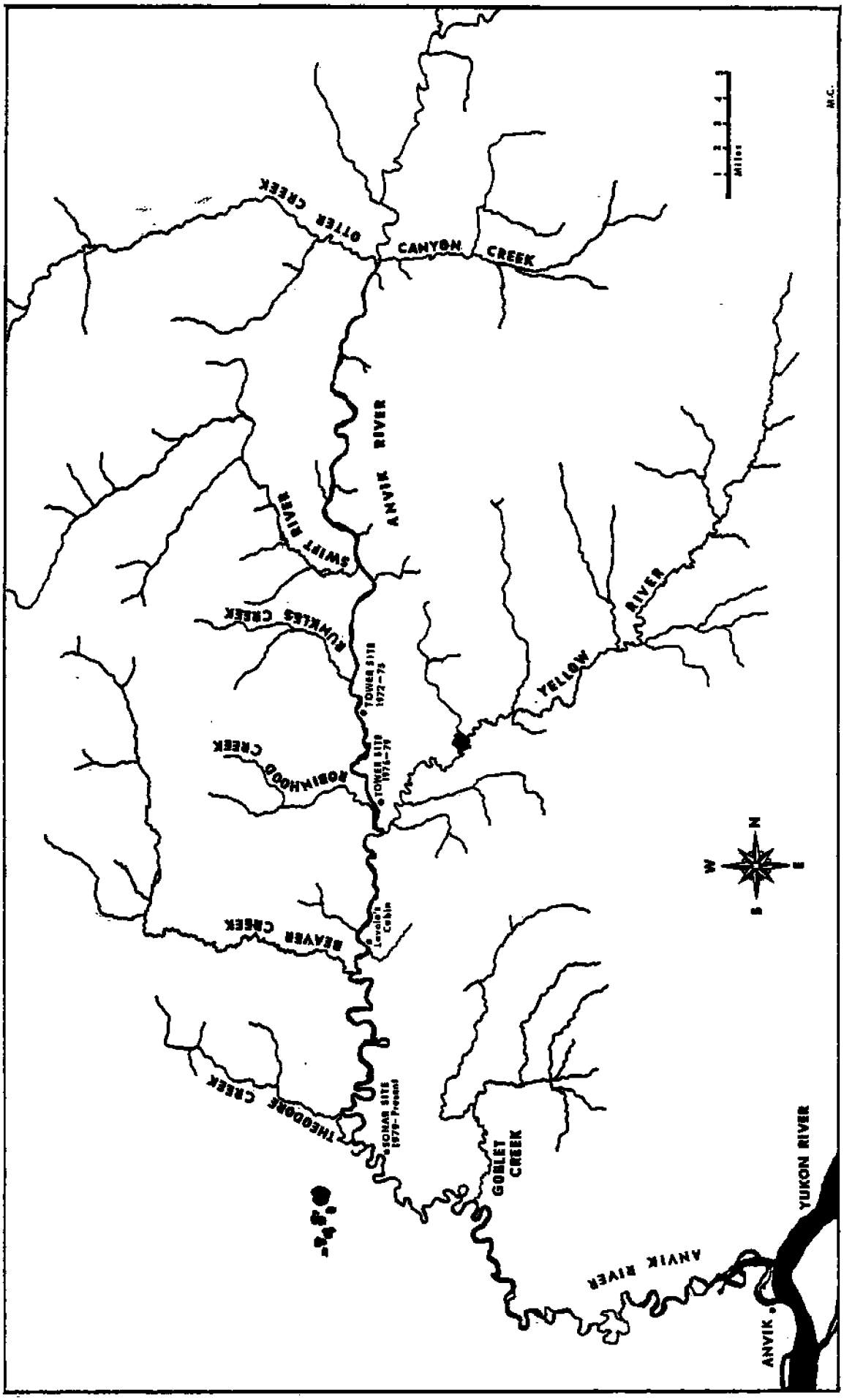


Figure 2. Map of the Anvik River.

a side-scanning sonar counter during the 1970's capable of detecting and counting salmon migrating along the banks of tributary streams. The sonar counter is designed to transmit a sonic beam along a 60 foot aluminum tube, or substrate. Echoes from salmon passing through the beam are reflected back to the transducer. The system electronics interpret the strength and number of the echoes, and tally salmon counts. Criteria for strength and frequency of the echoes are designed to optimize counting of salmon and minimize any non-salmon counts (ie debris or other fish species). Salmon escapement was enumerated by sonar beginning in 1979, replacing and proving superior to the tower counting method. One sonar counter has been installed on each bank of the Anvik River near Theodore Creek each year. Aerial survey data indicates that virtually all summer chum salmon spawners are found upstream of this site.

Methods and Materials

Two 1978 model sonar counters were operated without artificial aluminum substrate tubes throughout the season for the second consecutive year. Each sonar transducer was mounted on a rectangular aluminum frame. The east and west bank sites used in previous years were probed to locate uniform river bottom gradients that would provide optimum surfaces for insonification. Two steel pipes were set into the river bottom on each side of the river, onto which the transducer frames were guided by side mounted steel sleeves. Counting ranges were set such that the entire width of the river was insonified. Weirs prevented salmon passage inshore of the transducer on each bank. Transducers were moved inshore or offshore as required by fluctuating water levels.

Sonar counts were totaled electronically in twelve sectors for each bank and printed hourly. Sector counts missing as a result of debris or printer malfunction were estimated by averaging the counts in the same sector for the hour before and after the sector count in question. Counts were totaled daily for each bank using an electronic calculator, and the east and west bank totals summed to obtain a daily escapement estimate. Since summer chum salmon greatly outnumber chinooks and pinks, and the counters do not distinguish between species of salmon, all sonar counts were attributed to summer chum salmon. A separate escapement estimate for chinook salmon was obtained by aerial survey.

Each sonar counter was calibrated four times daily by observing fish passage with an oscilloscope for a 15 minute period. Salmon passing through the sonar beam produce a distinct oscilloscope trace. Sonar and oscilloscope counts for each calibration period were related in the formula: $Q=SS/SC$, where SS = side scan sonar counts, and SC = oscilloscope counts. The existing fish velocity setting was multiplied by Q to obtain the correct new setting if the difference between the counts was greater than 15%. The system was then recalibrated at the new setting. A record was kept of all adjustments to the sonar equipment. Fish passage was

visually enumerated from 10 ft counting towers during sonar calibration periods as a further check on sonar accuracy whenever water and light conditions allowed. Polaroid sunglasses were worn to reduce water surface glare.

Daily sonar counts were adjusted after the field season based on the calibration data. The daily adjustment factor is the sum of calibration oscilloscope counts for that day divided by the sum of calibration sonar counts for that day. Daily sonar counts were multiplied by the daily adjustment factor to obtain corrected daily sonar counts. Mean and standard deviation of date of passage were calculated following the method presented by Mundy (1982).

Water depth profile at the sonar site was measured at 3 m intervals across the width of the river by probing with a pole marked in 1 cm increments. Climatological data were collected at noon each day at the campsite. A pole marked in 1 cm increments was set in the river. Changes in water depth are presented as negative or positive from the initial reading of 0 cm. Water temperature was measured in degrees centigrade near shore, at a depth of about 0.5 m. Daily maximum and minimum air temperatures were recorded in degrees centigrade. Subjective notes were kept by the crew describing wind speed and direction, cloud cover, and precipitation.

A beach seine (100 ft long, 66 meshes deep, 2-1/2 in mesh) was set near the sonar site to capture chum and chinook salmon for age, sex, and size measurements. Chum and chinook salmon were placed in a holding pen, identified by sex, measured from mid-eye to fork of tail in mm, and one scale was taken for age determination. Scales were removed from an area posterior to the base of the dorsal fin and above the lateral line on the left side of the fish. The adipose fin was clipped on each fish before release to prevent resampling. Chinook salmon carcasses were sampled in August to supplement the beach seine sample. Three scales were taken from each carcass. Scale samples were later pressed on acetate cards and the resulting impressions viewed on a microfiche reader for age determination.

Results and Discussion

Two sonar counters were operated from 21 June through 15 July, at approximately the same sites used in previous years (Figure 3). The east bank transducer was located along a cutbank, 3.7 m offshore and at a depth of 87 cm. The west bank transducer was located along a gradually sloping gravel bar, approximately 60 m downstream from the east bank site. The transducer was 15.2 m offshore and at a depth of 61 cm. The entire width of the river between the transducers was insonified. River bottom gradient was smooth, with no obstructions to the sonar beam, and maximum depth was 149 cm as measured on 23 June (Figure 3).

River water level was of normal height for the time of year when

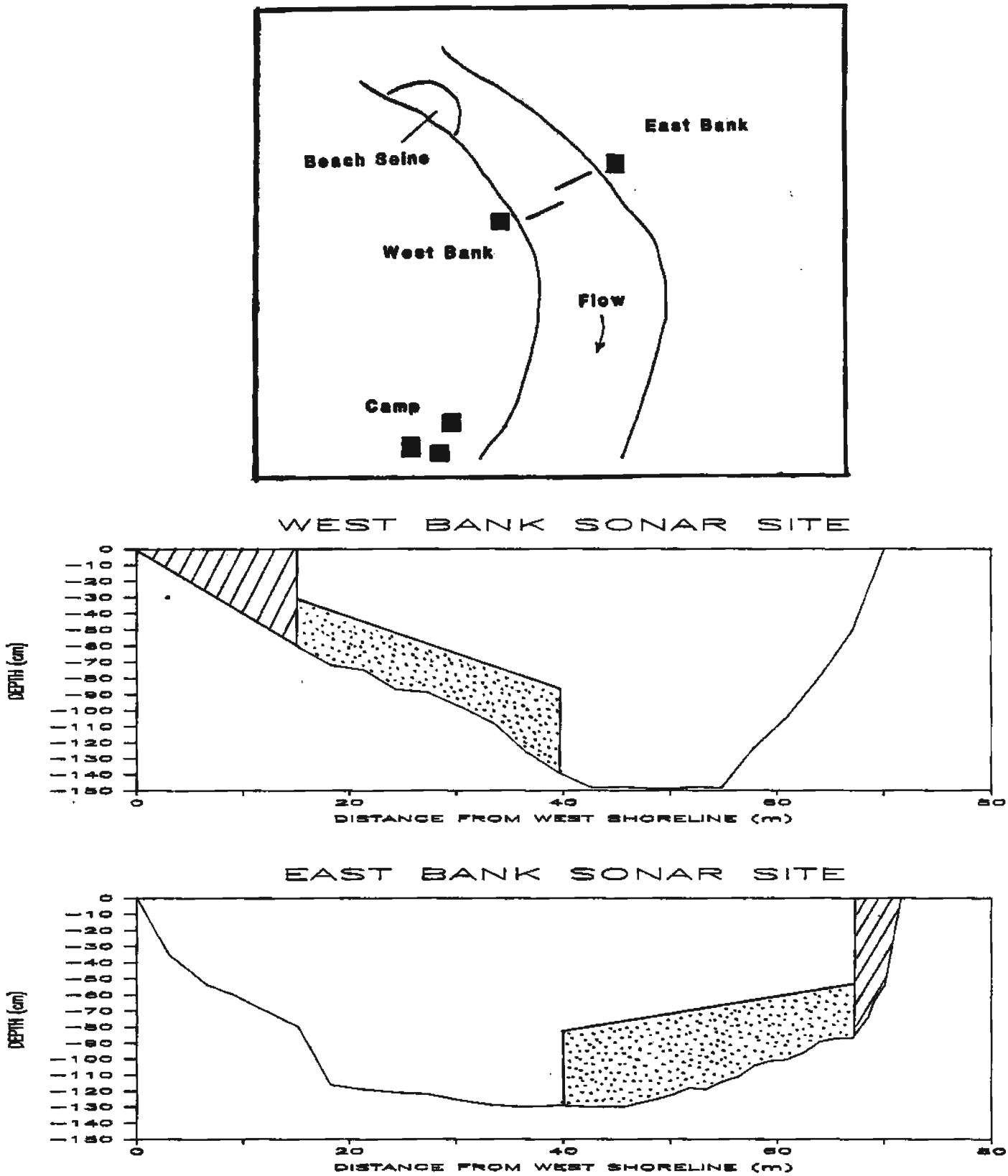


Figure 3. Map of the Anvik River sonar site, and river depth profiles as measured on 23 June, 1986 for the west bank and on 25 June, 1986 for the east bank. Shaded areas show approximate range of insonification on these dates, weirs are indicated with cross hatching. Unequal scale of the axes distorts the presentation.

the crew arrived to begin project operations. Below average snowpack in the drainage and below average rainfall in the spring and early summer resulted in steadily declining water levels throughout sonar project operation (Figure 4). Moderate increases in water level on 22 and 27 June were due to pulses of high water in the Yukon River from heavy rainfall in the upper portion of the Yukon River drainage. These pulses of high water had the effect of backing up the discharge of water from the Anvik River drainage. Water temperature ranged from a low of 9 C on 26 June to a high of 18 C on 5 July, while air temperature ranged from a low daily minimum of 2 C on 14 July to a high daily maximum of 29 C on 4 July.

Sonar enumeration was scheduled to continue until 28 July, if necessary, but emergency budget reductions resulted in termination of counting on 15 July. Significant numbers of fish were still being counted at that time. The adjusted escapement count for the period 21 June through 15 July was 1,085,750 summer chum salmon (Table 1). A peak adjusted daily count of 117,778 fish occurred on 30 June, which represented 10.8% of the total season sonar count. Escapement timing appeared to be relatively early, as it had been in 1979, 1981, and 1983 (Figure 5). Mean date of run passage was 3 July, with a standard deviation of 5.05 days. The calculated mean and standard deviation are affected by premature termination of the project.

The cumulative escapement count for the period 21 June through 15 July of 1,085,750 summer chum salmon can be expanded to a total season escapement estimate based on historical escapement timing patterns. An average of 8.73% of the total season sonar count occurred after 15 July for previous years (1979, 1981, and 1983) with an early timing pattern most similar to that of 1986. Applying this expansion factor results in a total season escapement estimate of 1,189,602 summer chum salmon for 1986.

Historical escapement timing patterns were used on an in-season basis to project the final escapement estimate for fishery management purposes. Sonar counts for the period 21-29 June input into the average timing curve for an early escapement timing pattern (based on 1979, 1981, and 1983) resulted in a projection of 1,291,000 summer chum salmon. This was within 9% of the actual final escapement estimate of 1,189,602 fish.

Buklis (1982) expanded the season escapement estimates for 1972 through 1978, making it possible to more directly compare visual count estimates from those years with the more recent sonar count estimates (Figure 6). The 1986 escapement estimate of 1,189,602 summer chum salmon was second only to the 1981 escapement of nearly 1.5 million fish, was 2.4 times greater than the escapement objective of 487,000 fish (ADFG 1985), and was 2.0 times greater than the long term (1972-1985) average of 587,714 fish.

A total of 24.23 hours of sonar calibration was conducted over a 25 day period at the west bank site, and sonar accuracy (sonar

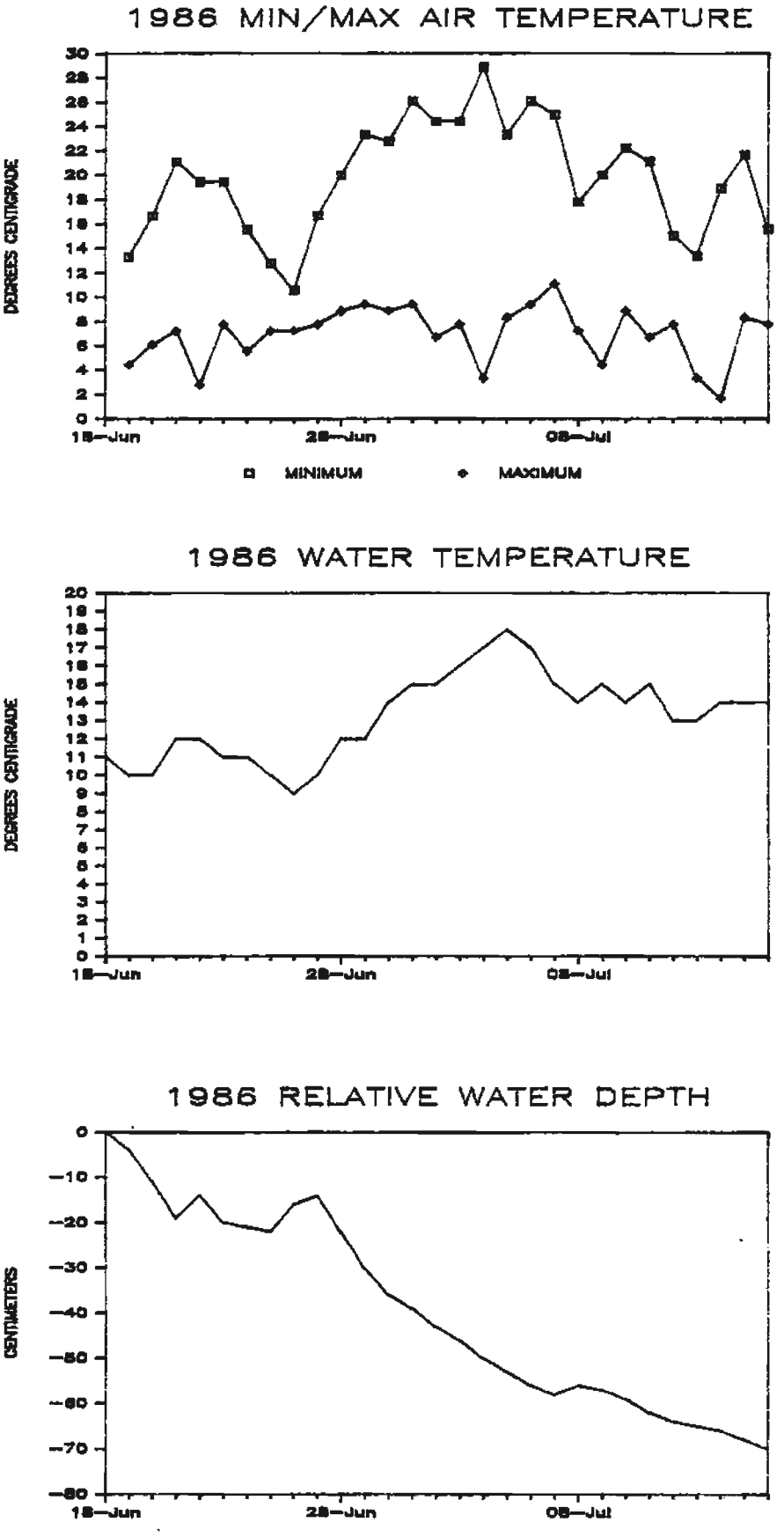


Figure 4. Air temperature (daily minimum and maximum), water temperature, and relative water depth measured at noon daily at the Anvik River sonar site, 1986.

Table 1. Anvik River summer chum salmon sonar counts by date, 1986.

Date	West Bank Raw Daily	West Bank Adjust Factor a	West Bank Correct Daily	East Bank Raw Daily	East Bank Adjust Factor a	East Bank Correct Daily	Entire River Daily Count	Entire River Season Count	Entire River Daily Prop	Entire River Season Prop
21-Jun	191	1.22	233	1	1.28 b	1	234	234	0.0002	0.0002
22-Jun	2,310	1.28	2,957	10	1.28 b	13	2,970	3,204	0.0027	0.0030
23-Jun	4,417	1.05	4,638	200	1.28 b	256	4,894	8,098	0.0045	0.0075
24-Jun	9,582	1.27	12,169	18	1.28 b	23	12,192	20,290	0.0112	0.0187
25-Jun	14,608	1.00	14,608	907	1.28	1,161	15,769	36,059	0.0145	0.0332
26-Jun	20,375	0.70	14,263	4,692	0.88	4,129	18,392	54,451	0.0169	0.0502
27-Jun	50,826	0.63	32,020	3,620	0.78	2,824	34,844	89,295	0.0321	0.0822
28-Jun	66,079	0.75	49,559	48,715	0.80	38,972	88,531	177,826	0.0815	0.1638
29-Jun	71,932	0.81	58,265	52,296	0.80	41,837	100,102	277,928	0.0922	0.2560
30-Jun	57,858	0.94	54,387	71,226	0.89	63,391	117,778	395,706	0.1085	0.3645
01-Jul	39,150	1.10	43,065	75,172	0.91	68,407	111,472	507,178	0.1027	0.4671
02-Jul	43,687	1.02	44,561	50,780	0.88	44,686	89,247	596,425	0.0822	0.5493
03-Jul	18,037	1.32	23,809	37,647	0.92	34,635	58,444	654,869	0.0538	0.6031
04-Jul	18,839	1.23	23,172	41,657	0.86	35,825	58,997	713,866	0.0543	0.6575
05-Jul	18,728	1.01	18,915	20,998	1.00	20,998	39,913	753,779	0.0368	0.6942
06-Jul	30,000	1.09	32,700	26,070	0.89	23,202	55,902	809,681	0.0515	0.7457
07-Jul	26,804	1.03	27,608	17,325	1.02	17,672	45,280	854,961	0.0417	0.7874
08-Jul	22,960	0.93	21,371	14,634	1.32	19,317	40,688	895,649	0.0375	0.8249
09-Jul	20,959	0.89	18,654	21,781	1.03	22,434	41,088	936,737	0.0378	0.8628
10-Jul	14,226	1.45	20,628	19,695	0.88	17,332	37,960	974,697	0.0350	0.8977
11-Jul	14,518	1.45	21,051	7,639	1.01	7,715	28,766	1,003,463	0.0265	0.9242
12-Jul	10,534	1.03	10,850	5,623	0.96	5,400	16,250	1,019,713	0.0150	0.9392
13-Jul	9,673	0.93	8,996	4,808	1.06	5,096	14,092	1,033,805	0.0130	0.9522
14-Jul	15,491	1.03	15,956	6,408	1.23	7,882	23,838	1,057,643	0.0220	0.9741
15-Jul	18,914	0.98	18,536	7,845	1.22	9,571	28,107	1,085,750	0.0259	1.0000
Totals	620,718		592,971	539,769		492,779		1,189,602 c		

a Adjustment factor is the daily sum of calibration oscilloscope counts divided by the daily sum of calibration sonar counts. See Tables 2 and 3 for sonar calibration data.

b Too few fish were counted during calibration periods to obtain an accurate daily count adjustment factor. The adjustment factor of 1.28 for 25 June was used, as this was the first measure of counting accuracy based on a sufficient sample.

c Cumulative escapement count for the period 21 June through 15 July of 1,085,750 summer chum salmon was expanded to a total season estimate of 1,189,602 fish based on historic escapement timing patterns. An average of 8.73% of the total season sonar count occurred after 15 July for previous years (1979, 1981, and 1983) with an early timing pattern most similar to that of 1986. Counting was terminated while significant fish passage was still occurring in 1986 due to funding cuts.

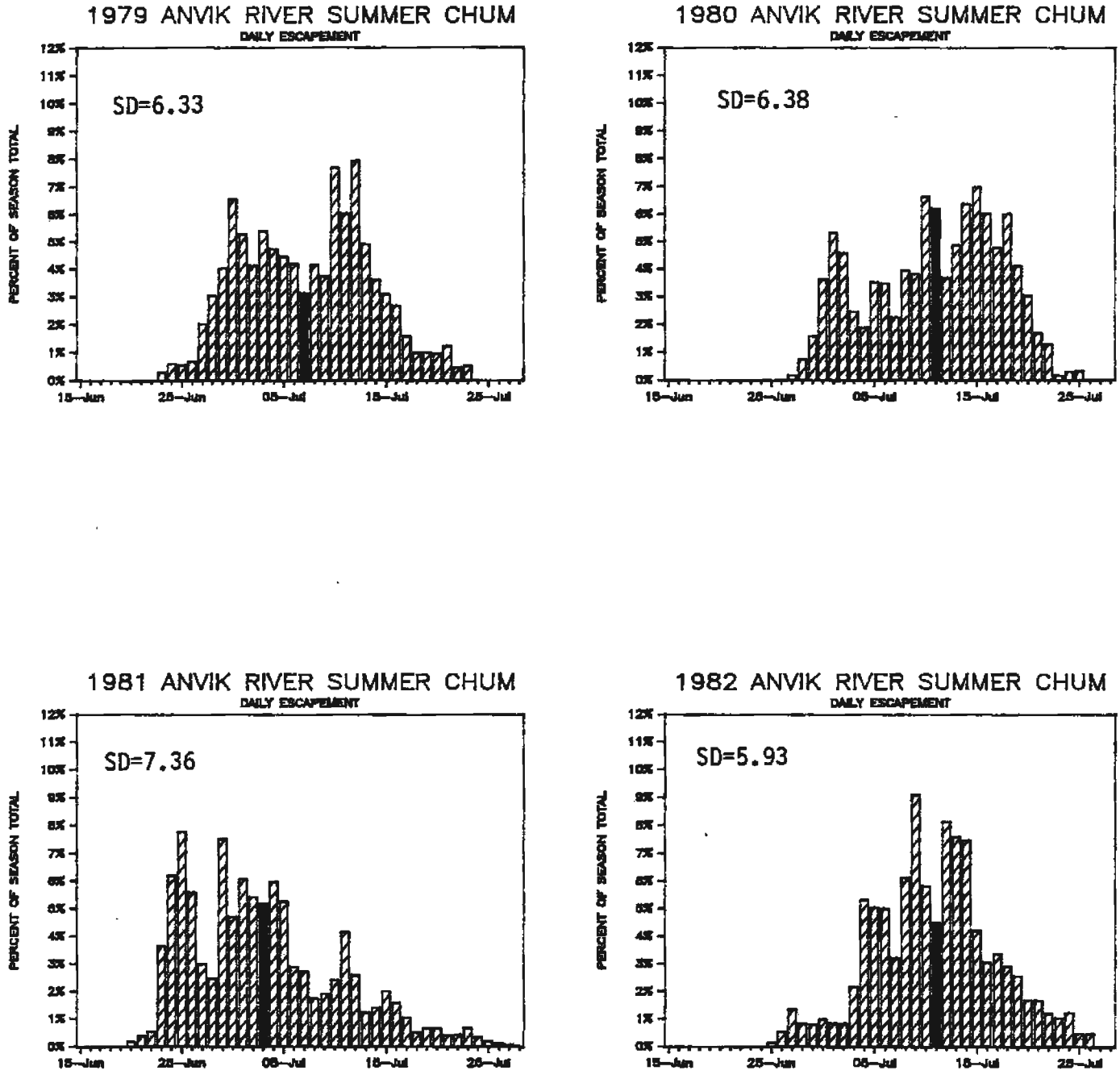


Figure 5. Anvik River summer chum salmon sonar counts by day, 1979-1986. Mean date of run passage (calculated with Day 1 = 16 June) is indicated by shaded bar, and standard deviation (SD) of the mean is given.

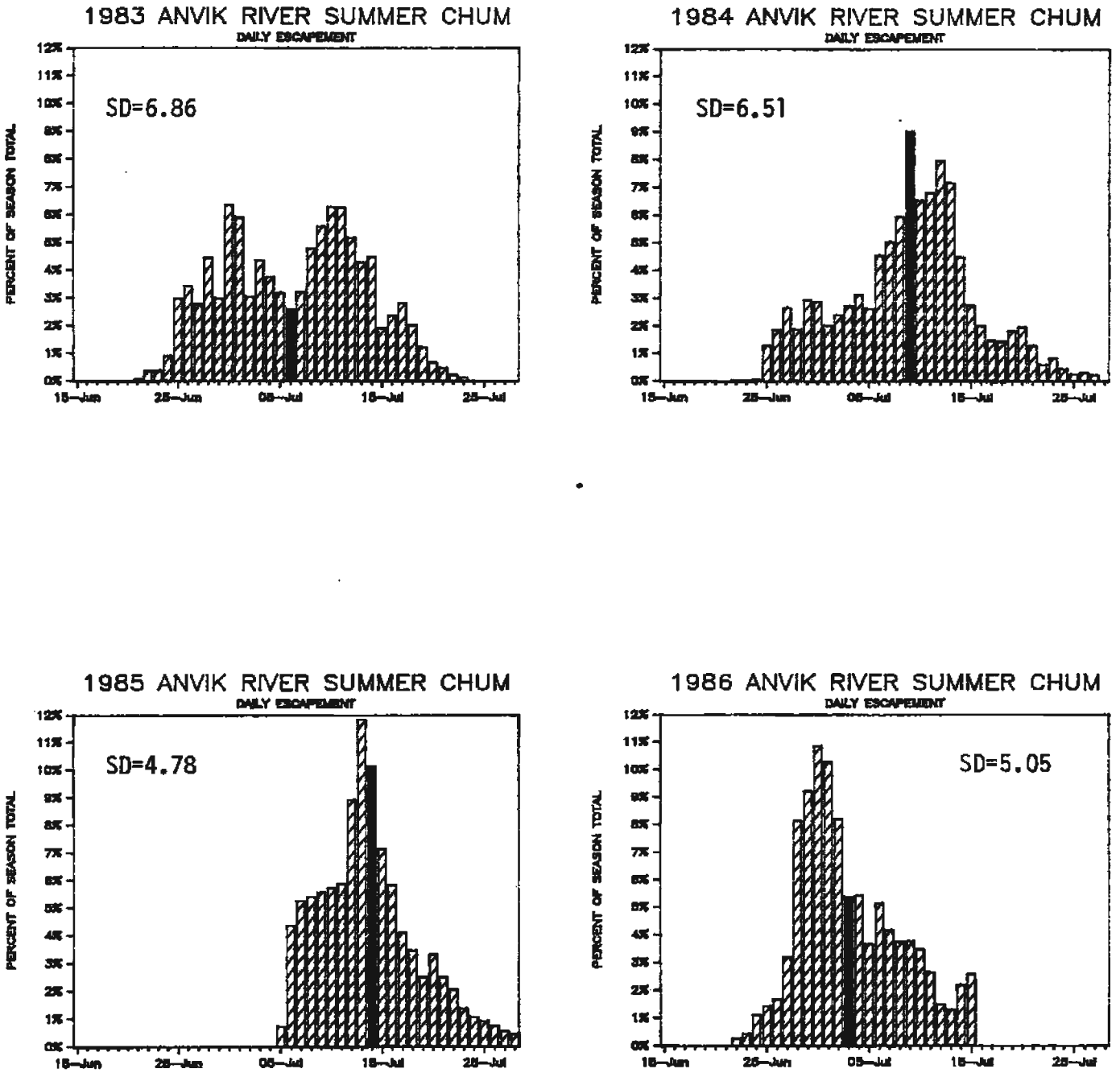


Figure 5. (Continued) Anvik River summer chum salmon sonar counts by day, 1979-1986. Mean date of run passage (calculated with Day 1 = 16 June) is indicated by shaded bar, and standard deviation (SD) of the mean is given.

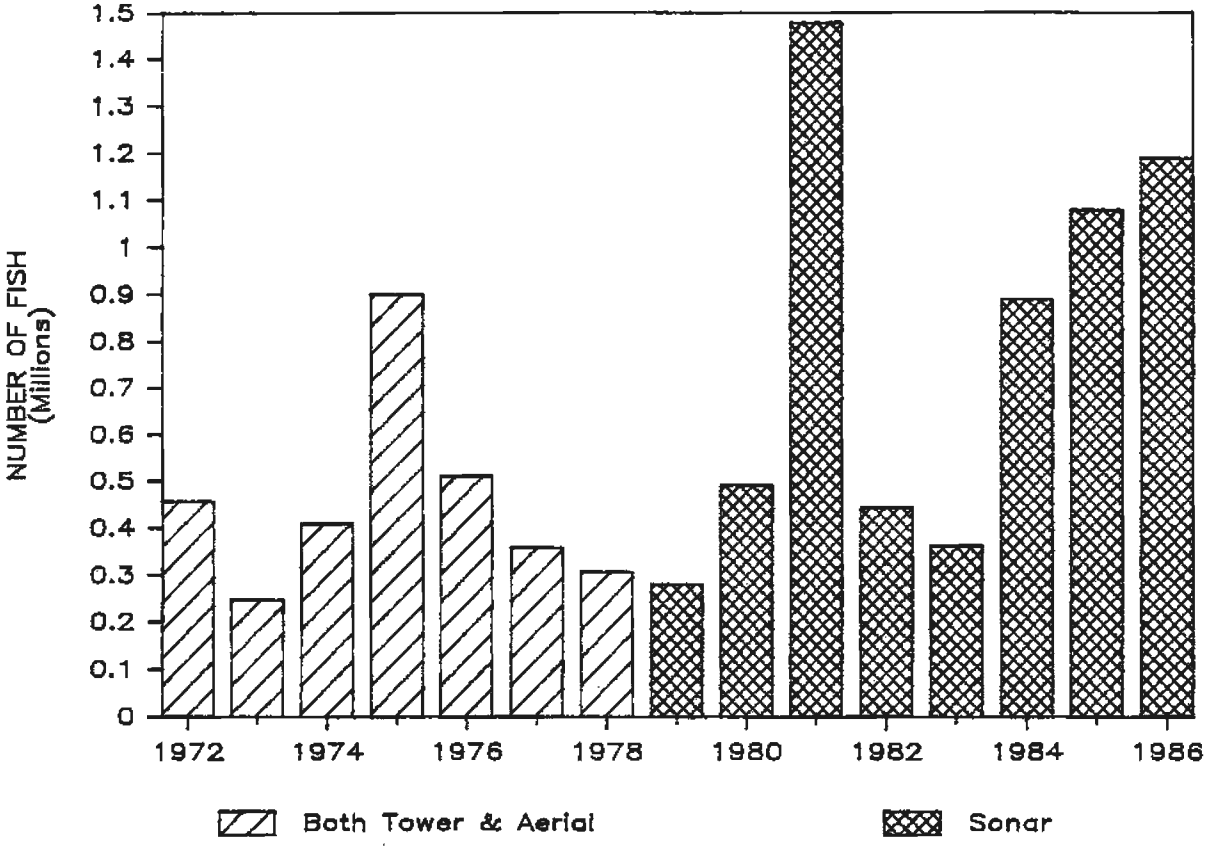


Figure 6. Anvik River summer chum salmon escapement estimated by combined tower and aerial survey counts, 1972-1978, and by side-scanning sonar, 1979-1986.

count/oscilloscope count) averaged 1.07 (Table 2). Although visual counts were not used to directly calibrate the sonar electronics due to frequently poor visual counting conditions, they did provide a measure of salmon species composition and an assessment of sonar aiming and counting accuracy. A net upstream total of 11,793 chum salmon, 9 chinook salmon, and 205 pink salmon was visually enumerated at the west bank site during all calibration periods combined. Sonar accuracy averaged 1.10 for 23.54 hours of oscilloscope calibration at the east bank site over a period of 25 days (Table 3). A net upstream total of 17,569 chum salmon, 29 chinook salmon, and 154 pink salmon was visually enumerated during these calibration periods. Daily calibration oscilloscope and sonar counts for each bank were used to adjust the daily sonar counts for that bank, which were then summed to obtain corrected daily escapement estimates.

The transducer deployment method used in 1986 proved to be very effective. It was easy to make adjustments to transducer aiming and positioning in response to changes in water levels and fish behavior. This method of deployment would have performed well in the high water conditions experienced in 1985, unlike the sonar substrate endpieces that were actually used (Buklis 1985).

Temporal distribution of the combined east and west bank unadjusted sonar counts by hour indicates a distinct diel pattern (Figure 7). This pattern became more pronounced as the season progressed. Counts were lowest during 1300-1400 (2.8% of daily total) and greatest during 0100-0200 (5.6% of daily total) for the entire season combined.

Spatial distribution of sonar counts by sector indicates that most of the salmon passage occurred in the first two sectors of the west bank and the first three sectors of the east bank (Figure 8). Most of the salmon passage occurred along the west bank during the first few days of enumeration, but substantial numbers of fish were counted along the east bank beginning on 28 June. For the entire season and both banks combined, west bank sectors 1 and 2 accounted for 53% of all unadjusted sonar counts, while east bank sectors 1,2, and 3 accounted for 45%.

An aerial survey of the Anvik River (including Otter Creek, McDonald Creek, and Yellow River) was flown on 28 July under good survey conditions. Survey timing was late due to poor weather and stream conditions earlier in the optimal survey period of 20 to 31 July. A total of 1,118 chinook salmon was enumerated. This was the largest chinook salmon escapement count for the Anvik River drainage since 1980. The count of 918 chinook salmon in the mainstem Anvik River between Yellow River and McDonald Creek achieved the aerial survey escapement objective of 300 to 500 chinook salmon for this index area (ADFG 1985). An accurate summer chum salmon escapement count could not be obtained due to the late timing of the survey.

Forty-six beach seine sets were made from 22 June to 14 July, and a total of 521 chum salmon, 3 chinook salmon, and 21 pink salmon

Table 2. Oscilloscope and visual calibration of salmon sonar counts at the Anvik River west bank site, 1986.

Date	Hours Count	Sonar Count	Scope Count	Sonar/ Scope	Visual Count a								
					Chum			Chinook			Pink		
					Up	Down	Net	Up	Down	Net	Up	Down	Net
21-Jun	1.00	14	17	0.82	10	0	10						
22-Jun	0.88	58	74	0.78	44	0	44						
23-Jun	1.50	173	182	0.95	127	0	127						
24-Jun	1.42	166	209	0.79	150	0	150						
25-Jun	1.53	688	686	1.00	339	0	339						
26-Jun	1.08	644	454	1.42	370	0	370						
27-Jun	0.83	1,353	976	1.39	446	0	446						
28-Jun	0.50	1,481	1,115	1.33	1,135	0	1,135						
29-Jun	1.00	2,641	2,153	1.23	2,047	0	2,047	1	0	1	3	0	3
30-Jun	1.00	1,580	1,494	1.06	1,355	0	1,355				5	0	5
01-Jul	0.75	761	836	0.91	769	0	769	1	0	1	3	0	3
02-Jul	0.83	488	499	0.98	540	0	540				3	0	3
03-Jul	1.00	389	510	0.76	568	3	565				2	0	2
04-Jul	1.00	493	611	0.81	462	4	458				2	0	2
05-Jul	0.92	487	494	0.99	386	2	384	1	0	1			
06-Jul	0.75	784	850	0.92			0						
07-Jul	0.83	823	849	0.97	352	3	349				5	0	5
08-Jul	1.08	831	779	1.07	777	2	775				22	0	22
09-Jul	0.75	368	330	1.12	252	3	249	1	0	1	12	0	12
10-Jul	0.83	272	396	0.69	275	6	269				4	0	4
11-Jul	1.00	221	318	0.69	167	3	164	3	0	3	4	0	4
12-Jul	0.83	205	212	0.97	134	2	132	1	0	1	8	0	8
13-Jul	1.17	311	292	1.07	251	7	244				21	0	21
14-Jul	1.00	594	614	0.97	606	2	604	1	0	1	71	0	71
15-Jul	0.75	370	361	1.02	272	4	268				40	0	40
Totals	24.23	16,395	15,311	1.07	11,834	41	11,793	9	0	9	205	0	205

a Visual counts are listed as upstream or downstream with "net" being the difference between the two. Errors in species identification or enumeration of fish may have been made due to poor water clarity, surface glare, oblique angle of vision, and lack of background contrast against the natural river bottom. In addition, visual counting was not conducted during all calibration periods due to the offshore movement of fish under certain conditions when a tower observer was present.

Table 3. Oscilloscope and visual calibration of salmon sonar counts at the Anvik River east bank site, 1986.

Date	Hours Count	Sonar Count	Scope Count	Sonar/ Scope	Visual Count a								
					Chum			Chinook			Pink		
					Up	Down	Net	Up	Down	Net	Up	Down	Net
21-Jun	1.00	0	9	0.00									
22-Jun	1.00	0	0	0.00									
23-Jun	1.00	3	12	0.25	3	0	3						
24-Jun	1.00	0	1	0.00									
25-Jun	1.23	99	127	0.78	7	0	7						
26-Jun	0.83	212	188	1.13	11	0	11						
27-Jun	0.58	85	66	1.29	83	0	83						
28-Jun	1.00	2,434	1,950	1.25	1,900	0	1,900						
29-Jun	1.00	2,115	1,695	1.25	1,522	0	1,522						
30-Jun	1.00	2,608	2,328	1.12	2,181	0	2,181						
01-Jul	0.75	2,618	2,370	1.10	2,291	0	2,291	1	0	1	2	0	2
02-Jul	0.83	1,655	1,466	1.13	1,377	1	1,376	3	0	3	8	0	8
03-Jul	0.83	1,322	1,208	1.09	1,033	0	1,033				7	0	7
04-Jul	0.83	1,540	1,329	1.16	1,223	0	1,223	2	0	2	6	0	6
05-Jul	0.83	925	928	1.00	888	0	888	1	0	1	5	0	5
06-Jul	1.00	1,366	1,216	1.12	1,169	0	1,169	4	0	4	4	0	4
07-Jul	1.00	674	691	0.98	610	2	608				1	0	1
08-Jul	1.00	453	594	0.76	389	2	387				2	0	2
09-Jul	1.08	1,014	1,050	0.97	1,045	1	1,044	7	0	7	11	0	11
10-Jul	0.92	1,090	962	1.13	886	4	882	4	0	4	20	0	20
11-Jul	1.00	344	349	0.99	246	3	243				6	0	6
12-Jul	0.83	198	191	1.04	103	1	102	1	0	1	2	0	2
13-Jul	1.17	274	290	0.94	145	0	145	2	0	2	13	0	13
14-Jul	1.08	345	425	0.81	344	4	340	4	0	4	38	0	38
15-Jul	0.75	172	210	0.82	132	1	131				30	1	29
Totals	23.54	21,546	19,635	1.10	17,588	19	17,569	29	0	29	155	1	154

a Visual counts are listed as upstream or downstream with "net" being the difference between the two. Errors in species identification or enumeration of fish may have been made due to poor water clarity, surface glare, oblique angle of vision, and lack of background contrast against the natural river bottom. In addition, visual counting was not conducted during all calibration periods due to the offshore movement of fish under certain conditions when a tower observer was present.

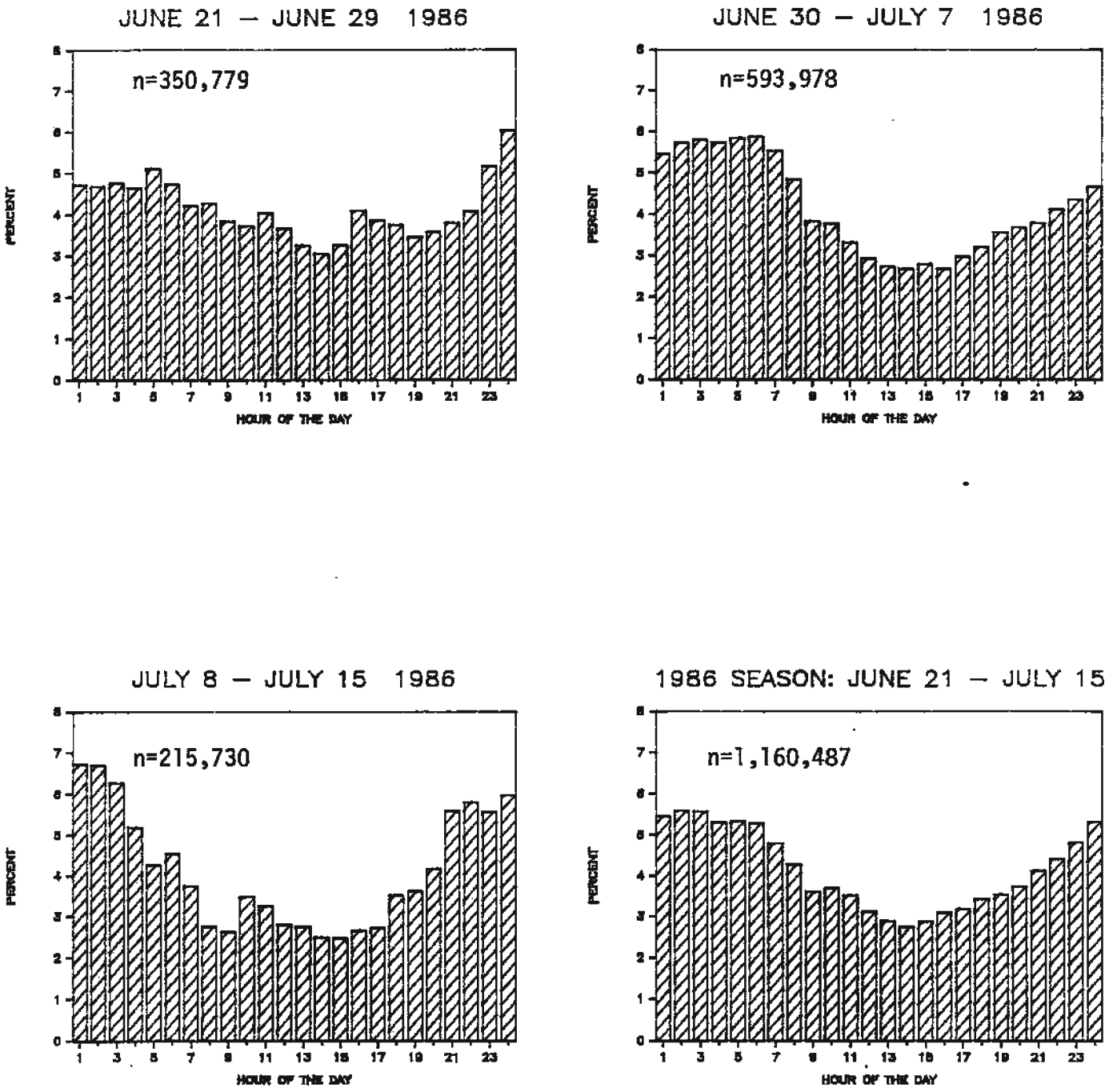


Figure 7. Anvik River summer chum salmon sonar counts by hour of the day for the early (21-29 June), middle (30 June-7 July), and late (8-15 July) portion of the season, and for the entire 1986 season combined. Total sonar counts (n) used for this analysis are given for each period.

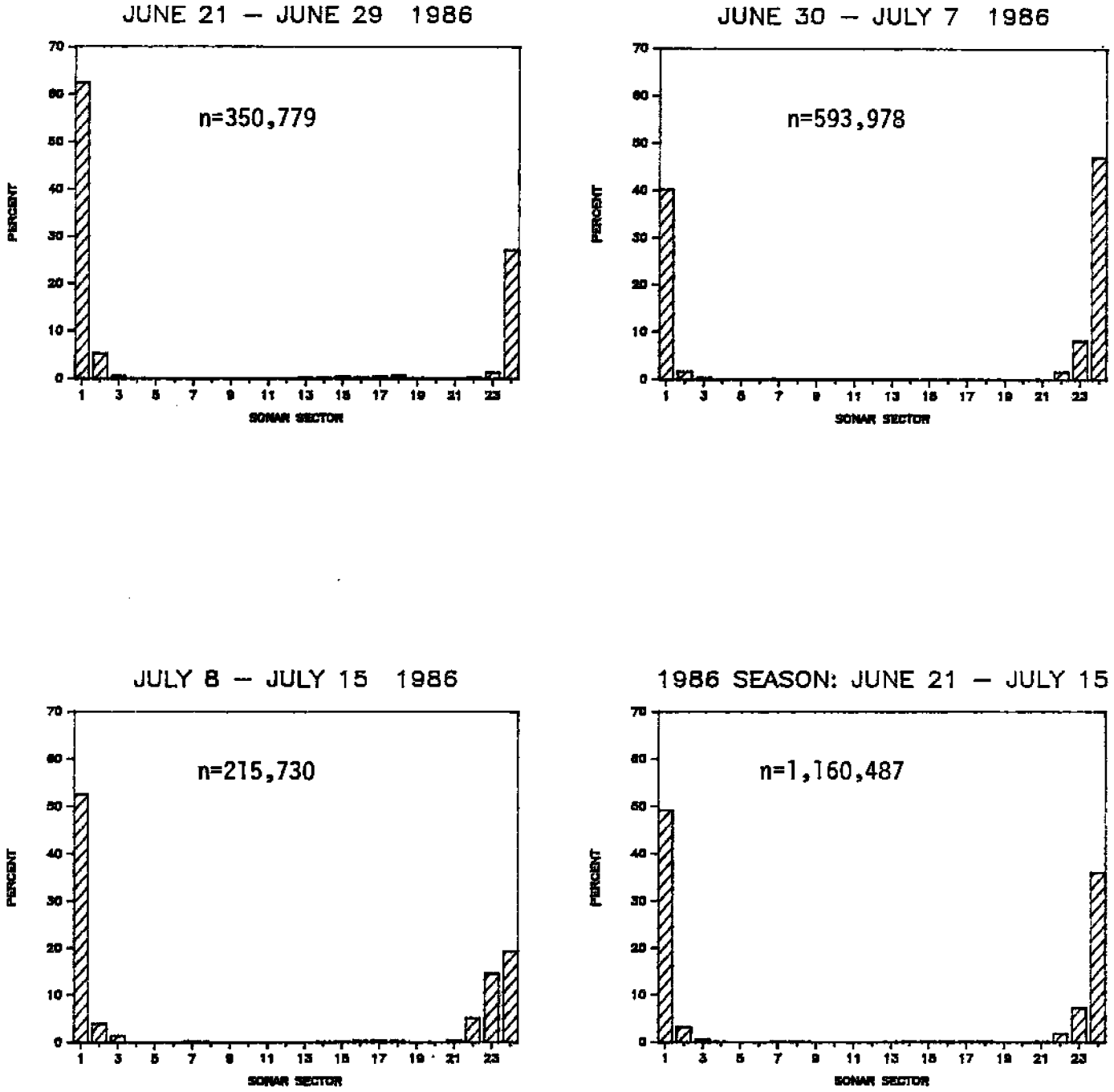


Figure 8. Anvik River summer chum salmon sonar counts by sonar sector for the early (21-29 June), middle (30 June-7 July), and late (8-15 July) portion of the season, and for the entire 1986 season combined. Sector 1 is west bank sector 1, 12 is west bank sector 12, 13 is east bank sector 12, and 24 is east bank sector 1. Total sonar counts (n) used for this analysis are given for each period.

was captured (Appendix Table 1). An attempt was made to collect additional chinook salmon samples by carcass survey in August. Due to heavy rainfall from mid-July through August and resulting high water conditions, only 145 chinook salmon were sampled by carcass survey from 10 to 20 August.

Of the 521 chum salmon sampled for age-sex-size data, 486 (93%) later proved to have ageable scales. Age composition was 68% age 5, 30% age 4, 0.4% age 3, and 1.4% age 6 (Appendix Table 2). Females accounted for 58% of the sample. Age 4 usually accounts for the majority of the Anvik River escapement. Age 5 was stronger in 1972, 1976, and 1981, but in all other years since 1972 age 4 has been the predominant age class (Figure 9). The strong contribution of age 5 fish to the 1986 escapement is a result of the record parent year escapement in 1981 of almost 1.5 million fish, and the below average escapement in 1982. Age composition of the lower Yukon River commercial catch varied by mesh size and progression of the run, but a strong age 5 component was apparent for all fishing periods sampled, similar to the escapement sample (Buklis and Merritt, In Prep).

Of the 148 chinook salmon sampled for age-sex-size data, 142 (96%) later proved to have ageable scales. Age composition was 1% age 4, 50% age 5, 38% age 6, and 11% age 7 (Appendix Table 3). Females accounted for 63% of the sample. Age 4 contribution was weaker than in previous years, ages 5 and 7 were relatively stronger, and age 6 was near average (Figure 10). The record female component is linked to the unusual contributions by ages 4 and 7. However, age and sex composition estimates may be biased by small sample size and the effect of river flooding on the availability of males, which die off earlier than females. Both the unrestricted and 6 in maximum mesh size gillnet commercial fisheries in the lower Yukon River caught a higher than normal proportion of ages 5 and 7 chinook salmon, and a lower proportion of ages 4 and 6 fish in 1986 (Buklis and Merritt, In Prep). This indicates poor brood year production from strong escapements in 1980, which is further supported by the poor contribution of age 5 fish to catch and escapement samples in 1985.

ANDREAFSKY RIVER SALMON STUDY

The Andreafsky River (Figure 11) includes two main branches, the East and West Forks, and is located 100 miles upstream from the mouth of the Yukon River. It typically ranks second to the Anvik River in summer chum salmon escapement, second to the Salcha River in chinook salmon escapement, and supports the largest pink salmon population in the Yukon River drainage. Salmon escapements were estimated annually in each fork by aerial survey from fixed wing aircraft prior to 1981. A side-scanning sonar counter was installed in the East Fork for the first time in 1981 to obtain more complete and accurate escapement information than could be obtained by aerial survey.

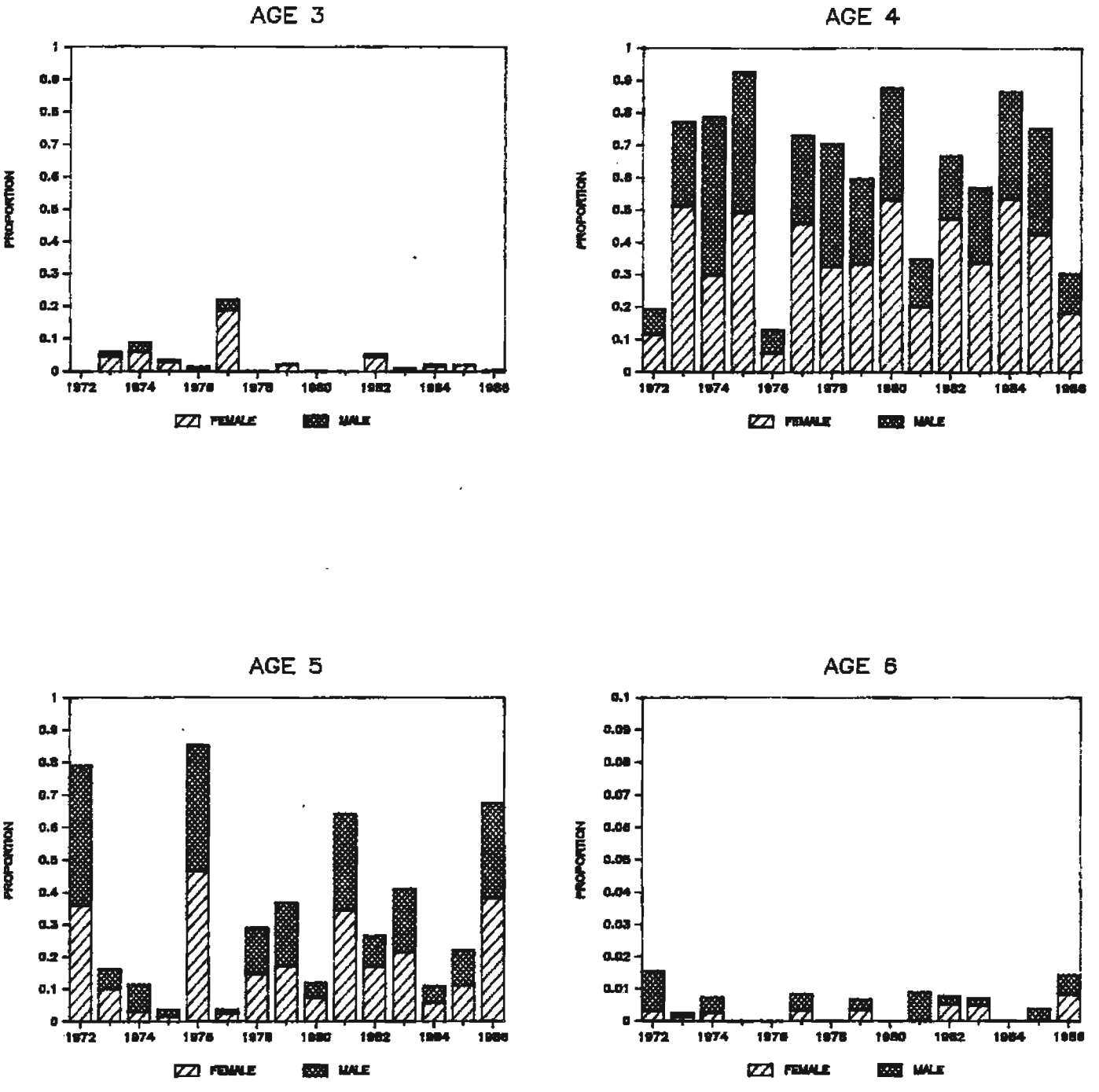


Figure 9. Age and sex composition of Anvik River summer chum salmon, 1972-1986, presented as proportion of total sample for each year by age class. Note different scale for age 6.

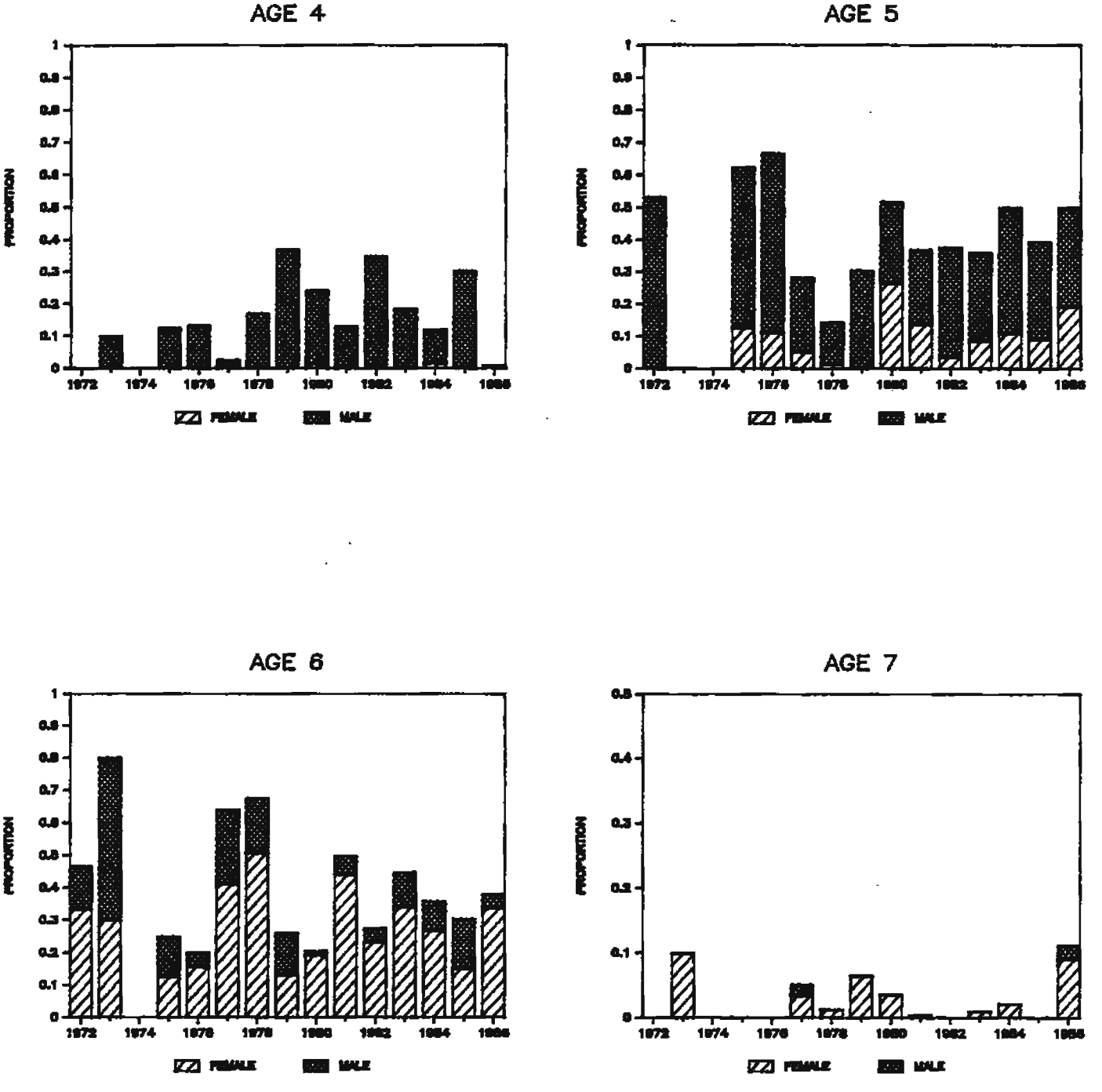
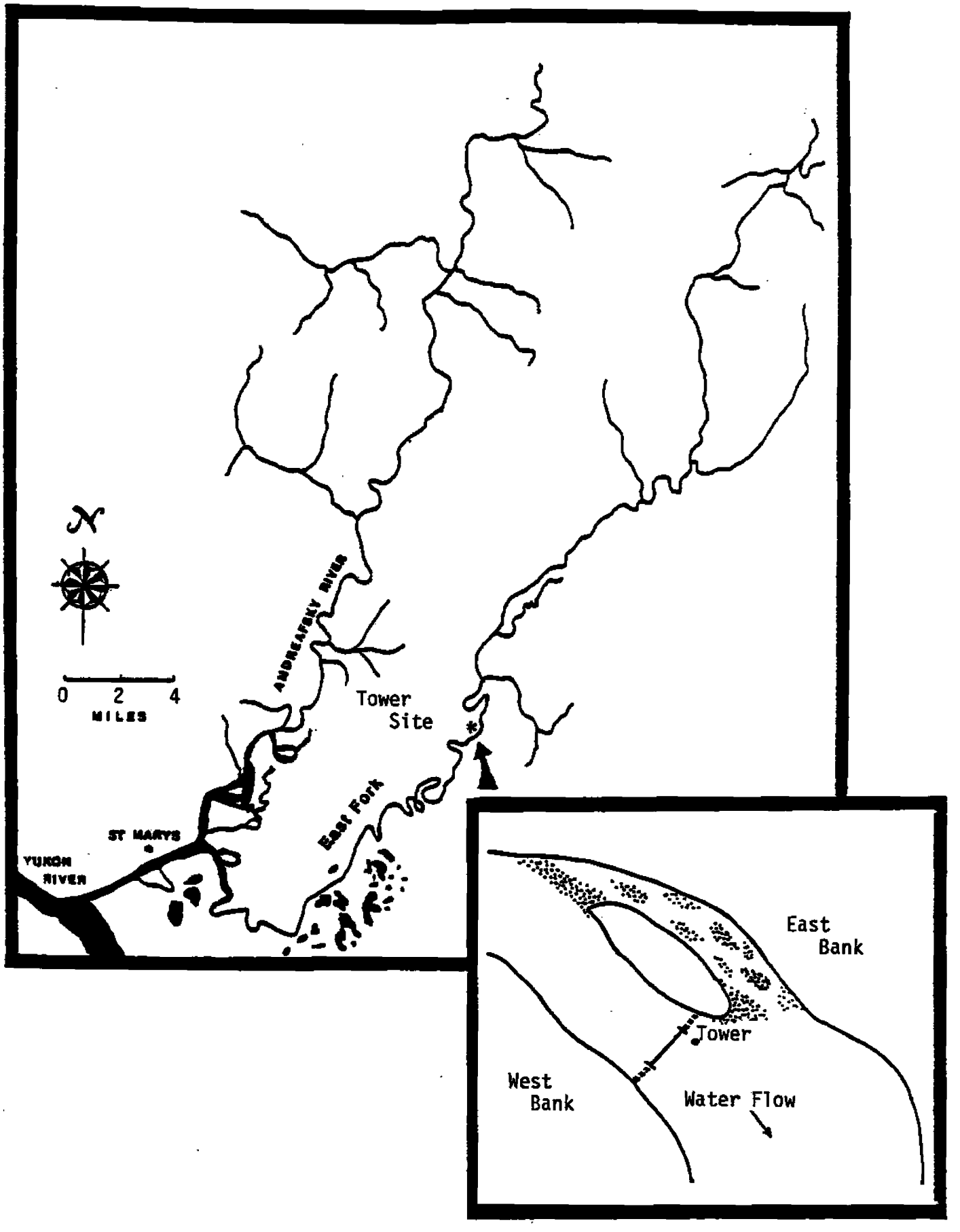


Figure 10. Age and sex composition of Anvik River chinook salmon, 1972-1986, presented as proportion of total sample for each year by age class. Note different scale for age 7.



p of the Andreafsky River, and of the tower site (inset) located
. river mile 20 of the East Fork.

The mainstem Andreafsky River, below the confluence of the East and West Forks, is not suitable for side-scanning sonar operation due to its width and slack current. The East Fork was chosen for sonar enumeration in 1981 because it supports a greater average summer chum salmon escapement than the West Fork, based on historical aerial survey data. In addition, a feasible sonar site could be located lower on the East Fork than on the West Fork, potentially enumerating a greater proportion of the spawners and simplifying logistics. There is also less recreational use of the East Fork by the residents of St Marys, a village of 500 people located near the confluence of the Andreafsky and Yukon Rivers.

Sonar was used to enumerate summer chum salmon escapements to the East Fork Andreafsky River from 1981 through 1984. Flood conditions in 1985 prohibited accurate sonar enumeration with the transducer deployment methods available at that time (Buklis 1985). As a result, an improved transducer deployment method was developed and was available for use on the Andreafsky River in 1986. This was the transducer deployment method applied on the Anvik River for the first time in 1986.

Large pink salmon escapements in 1982 and 1984 affected the accuracy of estimating summer chum salmon escapement using side-scanning sonar. A contingency plan was developed for 1986, whereby visual counting from towers would be used instead of sonar to estimate the 1986 escapement by species to the East Fork Andreafsky River if water conditions permitted. Water levels and clarity were favorable, and tower counting was successfully applied for the entire season for the first time in this stream.

Methods and Materials

The same site used previously for sonar enumeration was selected for the tower site. A weir was built from each shore, with an initial openning of approximately 13 m in the center for fish passage. This was reduced as water level decreased. The 20 ft tower was initially placed on the west side of the weir openning, then moved to the east side as visual conditions proved superior from that angle. A green plastic tarp was set on the river bottom across the weir openning to provide contrast for fish species identification and enumeration purposes. Polaroid sunglasses were worn during daylight hours, and 12 volt lamps were used to illuminate the weir openning during hours of darkness.

The project design initially was as follows. Each day was divided into 4 counting periods of 6 hr duration: 0000-0600, 0600-1200, 1200-1800, and 1800-2400. A counting schedule consisted of periods 1 and 3, or 2 and 4, and was followed for six consecutive days. Each of the two persons on the crew was assigned one 6 hr shift, for which that person would be responsible for the six day period. No counting was conducted on the seventh day. The alternate counting schedule was then implemented for the next six day period. Escapement counts were interpolated for the missing

day using the counts for the preceeding and following day.

Each hour on the half hour during his daily counting shift the observer counted fish passage by species and direction (ie upstream or downstream moving) for a 15 minute period using hand held talley counters. These counts were entered on a data form, and net upstream counts by species multiplied by 4 to obtain an hourly passage estimate for each salmon species. The resulting 12 hourly salmon counts were multiplied by 2 to obtain a daily escapement estimate for in-season management purposes. Post-season estimates presented in this report are refined by calculating the relationship between hourly passage rates across the entire season.

These methods were modified somewhat during the season as a result of the hourly distribution of counts. The day was divided into three counting periods: 0000-0800, 0800-1600, and 1600-2400. Counting was conducted during the third period each day. Counting was conducted during periods one and two on alternate days. The daily escapement was estimated during the season by summing counts for the two periods counted, and adding an interpolated estimate for the period not counted based on the preceeding and following day for that period. Post season estimates presented in this report are refined by calculating the relationship between hourly passage rates across the entire season.

Methods for measuring stream profile, recording climatological data, and sampling fish for age, sex, and size data were the same as those described previously for the Anvik River study.

Results and Discussion

The tower counting project was operational from 25 June through 14 July. The weir openning was approximately 13 m wide on 19 June, and maximum water depth was 130 cm (Figure 12). River water level was of normal height for the time of year when the crew arrived to begin project operations. Below average snowpack in the drainage and below average rainfall in the spring and early summer resulted in steadily declining water levels throughout tower project operation after an initial peak on 26 June (Figure 13). As for the Anvik River site, this peak was due to a pulse of high water in the Yukon River from heavy rainfall in the upper portion of the Yukon River drainage. Water clarity was good throughout the season. Water temperature ranged from a low of 9 C on 26 June to a high of 17 C on 4 July, while air temperature ranged from a low daily minimum of 2 C on 14 July to a high daily maximum of 29 C on 4 July.

The expanded escapement estimate for the period 25 June through 14 July was 152,730 summer chum salmon, 1,530 chinook salmon, and 124,618 pink salmon (Table 4). Expansion formulas were developed for each species and daily time block on a post-season basis (Appendix Tables 4-6) in order to obtain these escapement estimates. Tower enumeration was scheduled to continue until 28

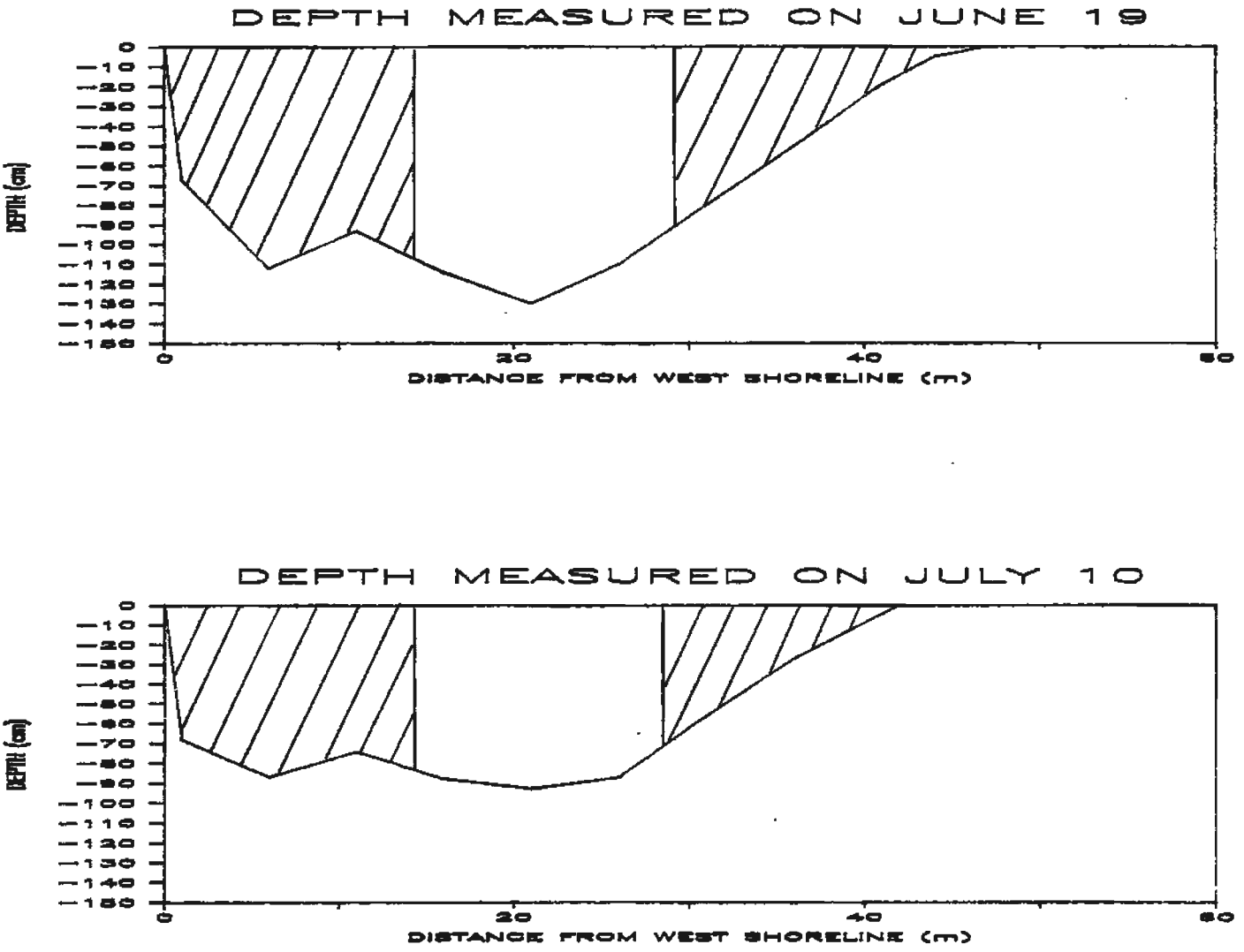
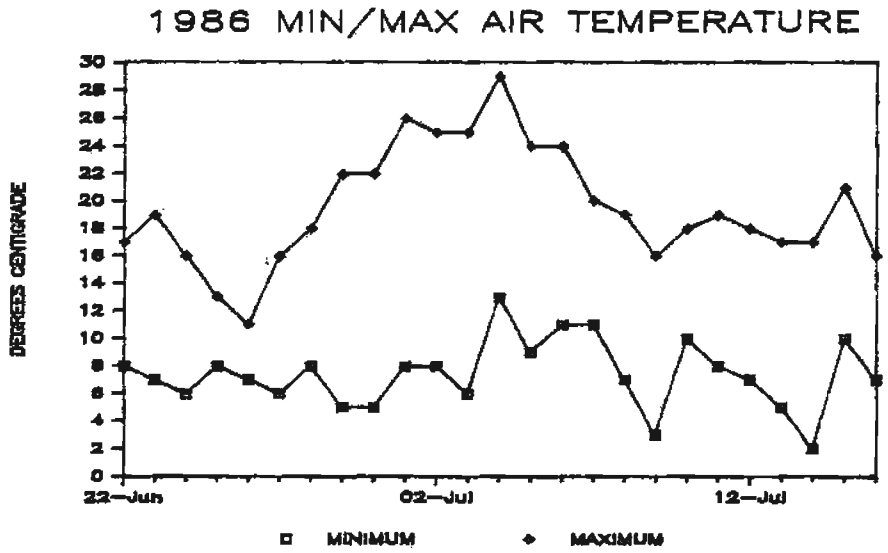
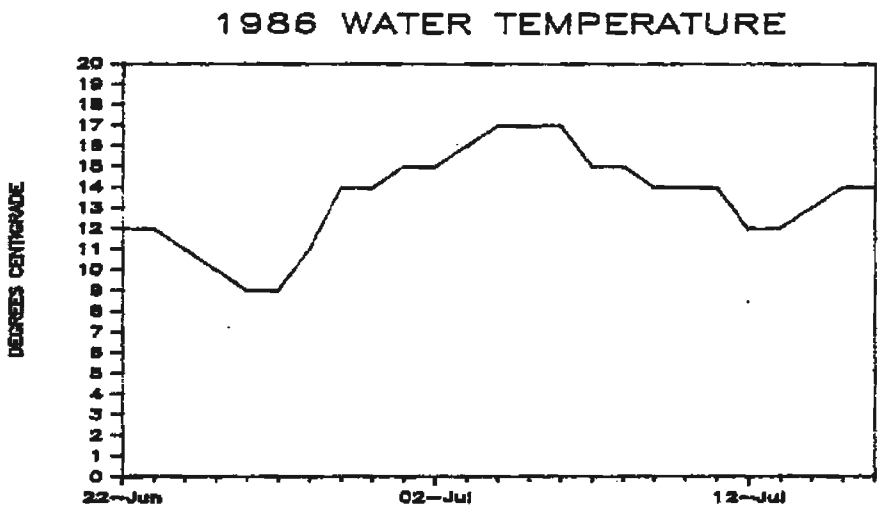


Figure 12. River depth profiles of the East Fork Andreafsky River tower site as measured on 19 June and 10 July, 1986. Cross hatching indicates weirs. Unequal scale of the axes distorts the presentation.





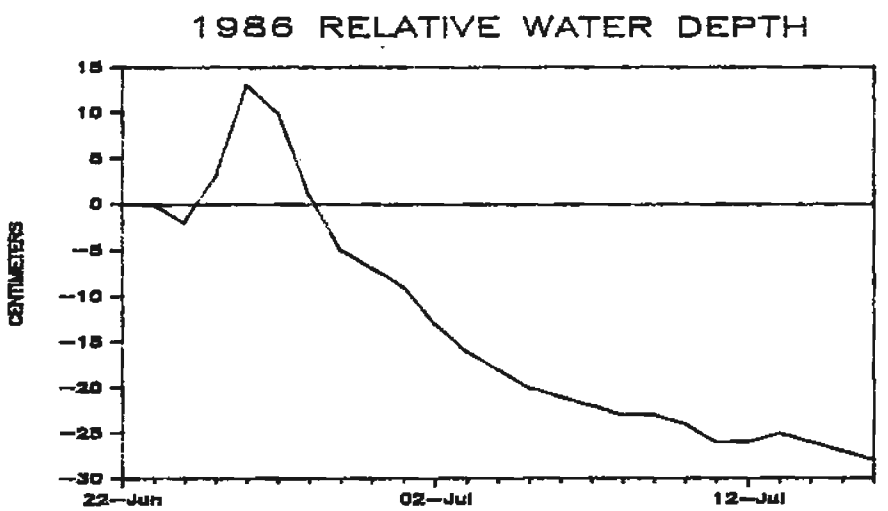


Figure 13. Air temperature (daily minimum and maximum), water temperature, and relative water depth measured at noon daily at the East Fork Andreafsky River tower site, 1986.

Table 4. East Fork Andreafsky River expanded tower counts of salmon escapement by species and date, 1986. a

Date	Summer Chum Salmon				Chinook Salmon				Pink Salmon			
	Daily Count	Total Count	Daily Prop	Total Prop	Daily Count	Total Count	Daily Prop	Total Prop	Daily Count	Total Count	Daily Prop	Total Prop
25-Jun	117	117	0.0008	0.0008	0	0	0.0000	0.0000	0	0	0.0000	0.0000
26-Jun	1,083	1,200	0.0071	0.0079	0	0	0.0000	0.0000	0	0	0.0000	0.0000
27-Jun	6,731	7,931	0.0441	0.0519	0	0	0.0000	0.0000	7	7	0.0001	0.0001
28-Jun	9,509	17,440	0.0623	0.1142	0	0	0.0000	0.0000	36	43	0.0003	0.0003
29-Jun	12,290	29,730	0.0805	0.1947	0	0	0.0000	0.0000	72	115	0.0006	0.0009
30-Jun	13,948	43,678	0.0913	0.2860	0	0	0.0000	0.0000	154	269	0.0012	0.0022
01-Jul	13,014 b	56,692	0.0852	0.3712	27 b	27	0.0176	0.0176	807 b	1,076	0.0065	0.0086
02-Jul	12,080 b	68,772	0.0791	0.4503	53 b	80	0.0346	0.0523	1,460 b	2,536	0.0117	0.0204
03-Jul	11,147	79,919	0.0730	0.5233	80	160	0.0523	0.1046	2,114	4,650	0.0170	0.0373
04-Jul	19,910	99,829	0.1304	0.6536	212	372	0.1386	0.2431	8,615	13,265	0.0691	0.1064
05-Jul	8,362	108,191	0.0548	0.7084	276	648	0.1804	0.4235	7,416	20,681	0.0595	0.1660
06-Jul	1,562	109,753	0.0102	0.7186	49	697	0.0320	0.4556	4,250	24,931	0.0341	0.2001
07-Jul	7,681	117,434	0.0503	0.7689	160	857	0.1046	0.5601	14,956	39,887	0.1200	0.3201
08-Jul	5,883 b	123,317	0.0385	0.8074	114 b	971	0.0745	0.6346	11,100 b	50,987	0.0891	0.4091
09-Jul	4,085	127,402	0.0267	0.8342	68	1,039	0.0444	0.6791	7,243	58,230	0.0581	0.4673
10-Jul	5,477	132,879	0.0359	0.8700	103	1,142	0.0673	0.7464	14,504	72,734	0.1164	0.5837
11-Jul	4,403	137,282	0.0288	0.8989	44	1,186	0.0288	0.7752	7,282	80,016	0.0584	0.6421
12-Jul	5,347	142,629	0.0350	0.9339	132	1,318	0.0863	0.8614	11,931	91,947	0.0957	0.7378
13-Jul	2,103	144,732	0.0138	0.9476	23	1,341	0.0150	0.8765	7,658	99,605	0.0615	0.7993
14-Jul	7,998	152,730	0.0524	1.0000	189	1,530	0.1235	1.0000	25,013	124,618	0.2007	1.0000
Totals		167,614 c				1,530 d				124,618 d		

a Hourly tower counts and daily expansion formulas are presented by species in Appendix Tables 4-6.
b Daily count estimated by interpolation of counts for preceding and following day due to scheduled day off or incomplete count data.
c Cumulative escapement count for the period 25 June through 14 July of 152,730 summer chum salmon expanded to a total season estimate of 167,614 fish based on historic sonar count escapement timing patterns. An average of 8.88% of the total season sonar count occurred after 14 July for the years 1981-1984. Counting was terminated while significant fish passage was still occurring in 1986 due to funding cuts.
d Cumulative escapement counts through 14 July of 1,530 chinook salmon and 124,618 pink salmon could not be expanded to total season escapement estimates due to the lack of historic daily escapement timing data for these species. Previous sonar projects were directed at summer chum salmon, and were terminated while significant numbers of chinook and pink salmon were still passing. Therefore, cumulative counts through 14 July for chinook and pink salmon are very conservative estimates of total season escapement, due to significant passage after that date.

July, if necessary, but emergency budget reductions resulted in termination of counting on 14 July. Significant numbers of fish were still being counted at that time.

The peak expanded daily summer chum salmon count of 19,910 fish (13% of season total) occurred on 4 July, the peak daily chinook salmon count of 276 fish (18% of season total) occurred on 5 July, while the peak daily pink salmon count of 25,013 fish (20% of season total) occurred on 14 July, the last day of counting. Escapement timing appeared to be about average for summer chum salmon as compared to the sonar counting data base for 1981-1984 (Figure 14). Mean date of run passage was 4 July, with a standard deviation of 4.76 days. The calculated mean and standard deviation are affected by premature termination of the project.

It is of interest to note that the low count of 1,562 summer chum salmon on 6 July may have been an effect of the commercial fishery in Districts 1 and 2. Approximately 54,000 summer chum salmon were taken in 12 hours in District 1 on 2 July, and an additional 30,000 fish were subsequently taken in District 2 in 12 hours on 3-4 July. Although stock composition of these catches is not known, significant contribution by the Andreafsky River stock would account for the low escapement count on 6 July.

The cumulative escapement count for the period 25 June to 14 July of 152,730 summer chum salmon can be expanded to a total season escapement estimate based on historical escapement timing patterns. An average of 8.88% of the total season sonar count occurred after 14 July for the years 1981-1984. Applying this expansion factor results in a total season escapement estimate of 167,614 summer chum salmon. This was the second largest summer chum salmon escapement recorded for the East Fork Andreafsky River since total population estimates have been obtained beginning in 1981, and is 32% greater than the 1981-1984 average sonar estimate of 127,349 fish (Figure 15).

Cumulative chinook and pink salmon escapement counts through 14 July could not be expanded to total season escapement estimates due to the lack of historic daily escapement timing data for these species. Cumulative proportion curves indicate that summer chum salmon had the earliest salmon escapement timing at the tower site, followed by chinook salmon and then pink salmon (Figure 16). Therefore, cumulative counts for chinook and pink salmon through 14 July of 1,530 and 124,618 fish, respectively, are incomplete escapement estimates.

A further error factor for the chinook salmon estimate is the relatively low passage rate and low counting intensity of the two person schedule design. Most counting towers are operated for 24 hours per day with a 3 person crew. By only counting for 15 minutes out of each of 16 hours daily, the occassional groups of migrating chinook salmon were easily missed or overestimated by expansion factors. The result is an erratic daily escapement pattern for chinook salmon, and an overall estimate that is probably too low. Methods for improving tower count estimates for

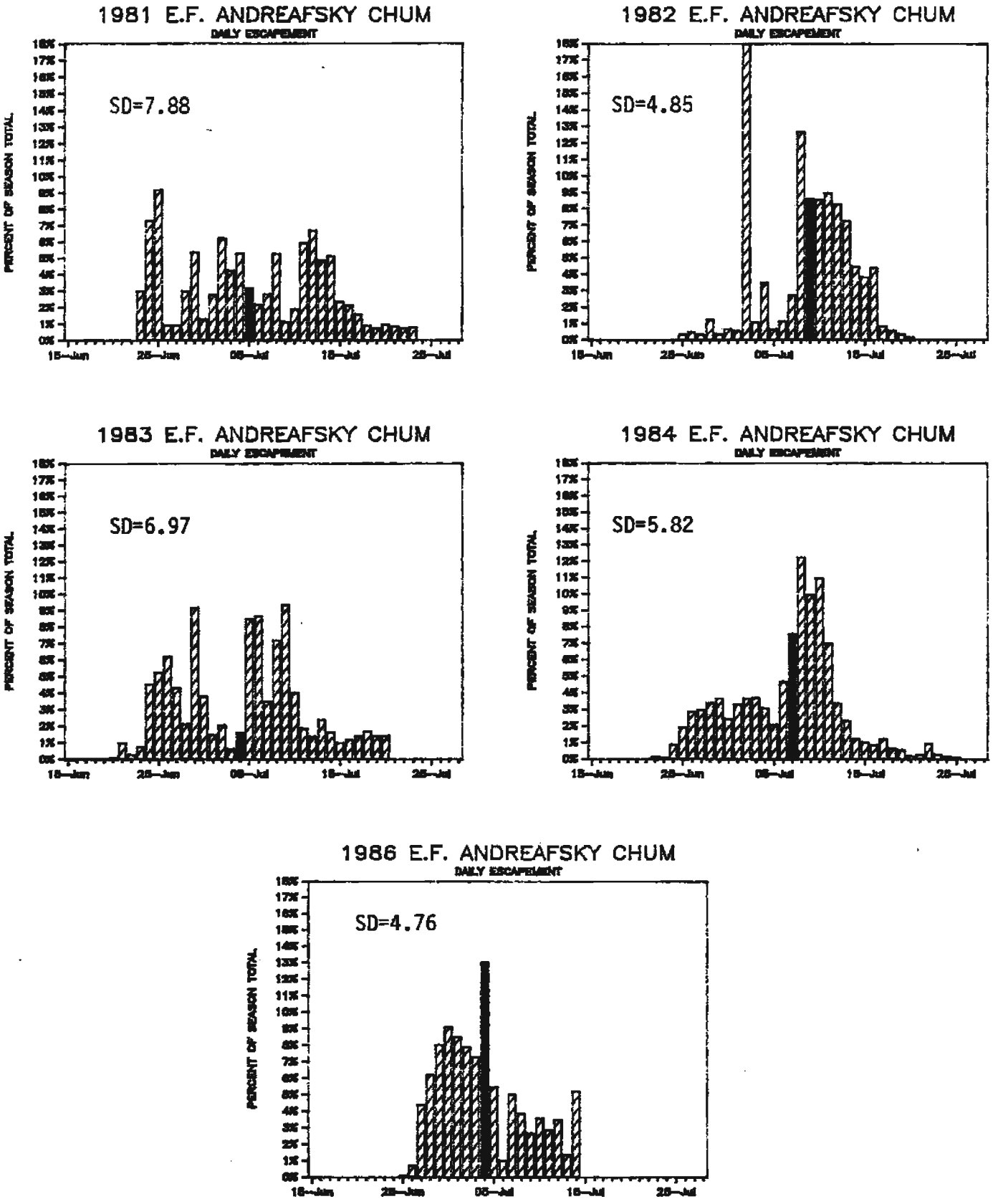


Figure 14. East Fork Andreafsky River summer chum salmon sonar or tower counts by day, 1981-1986. Mean date of run passage (calculated with Day 1 = 16 June) indicated by shaded bar, and standard deviation (SD) of the mean is given.

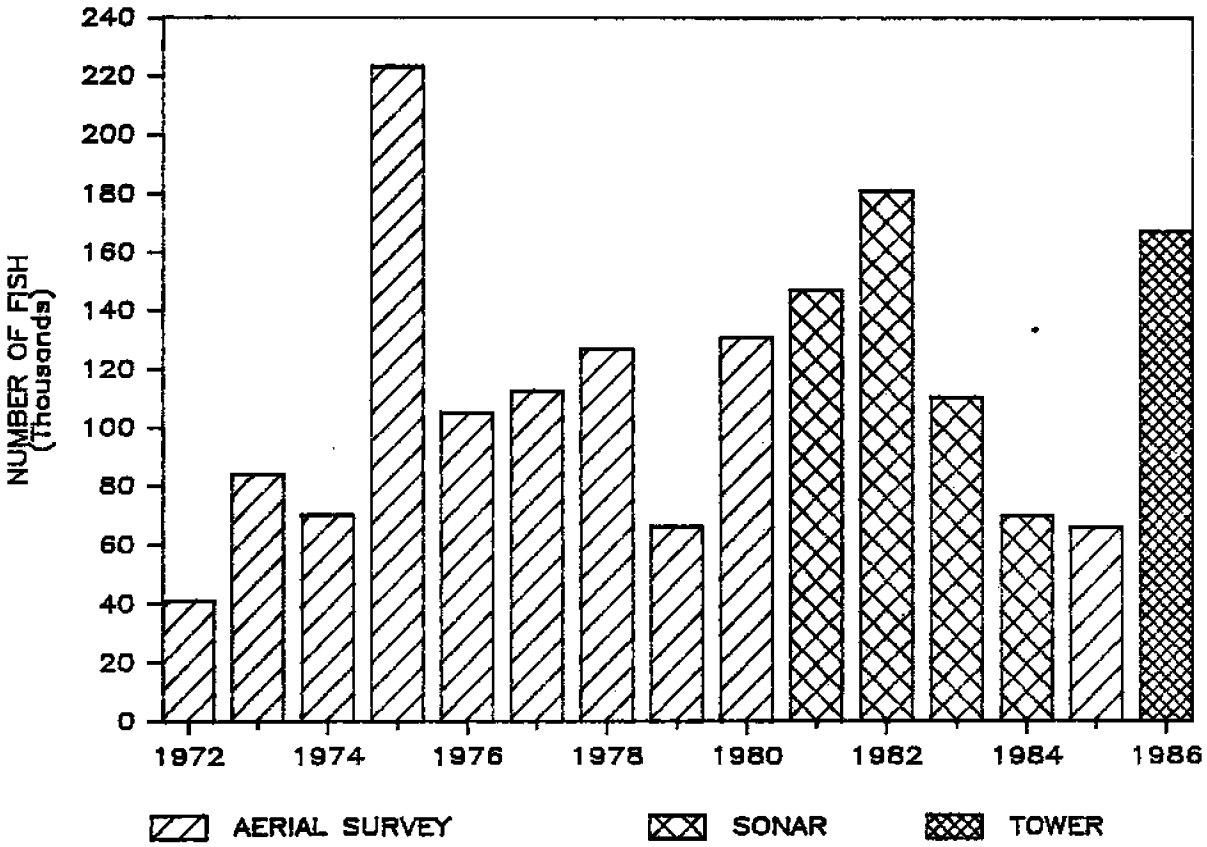


Figure 15. East Fork Andreafsky River summer chum salmon escapement as estimated by aerial survey, 1972-1980 and 1985, by side scanning sonar, 1981-1984, and by tower counts, 1986.

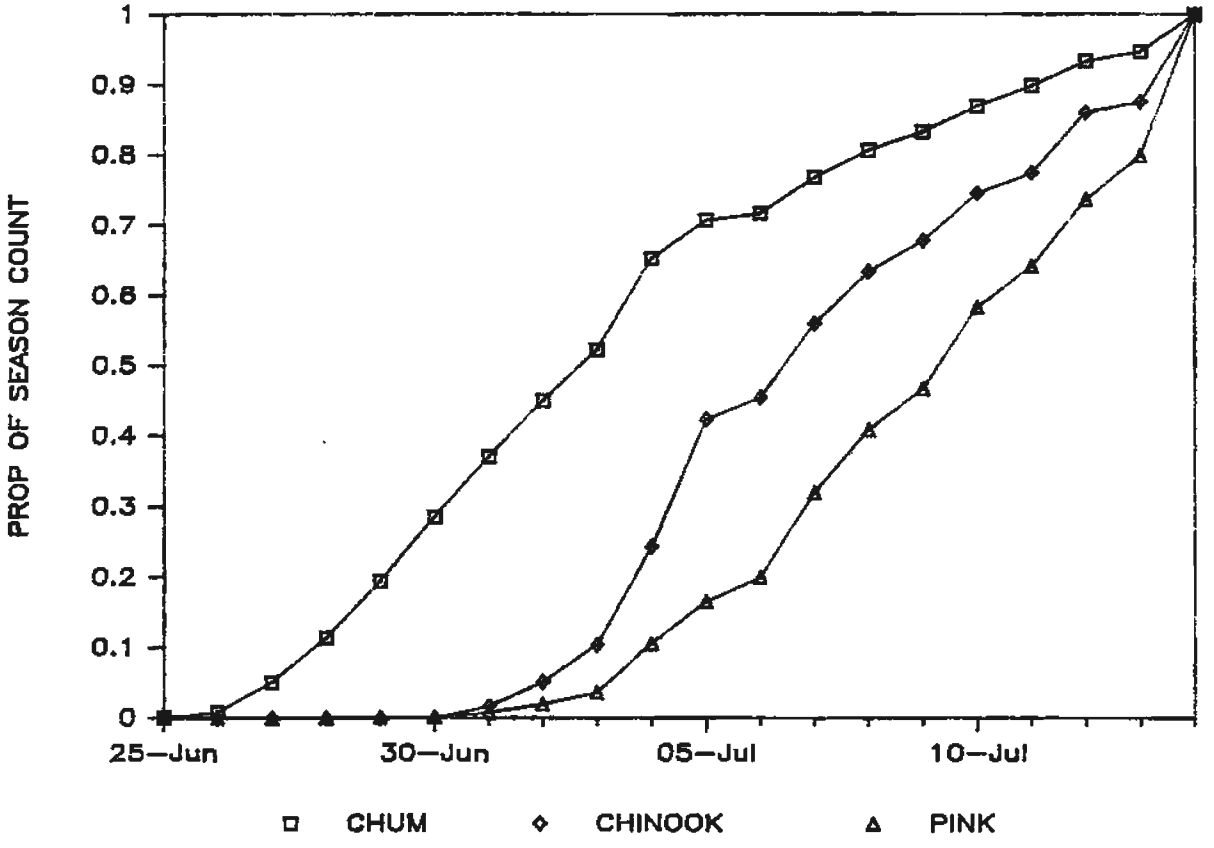


Figure 16. Cumulative proportion of season total summer chum, chinook, and pink salmon tower counts by date at the East Fork Andreafsky River, 1986.

1987 are discussed in the final section of this report (Conclusions and Recommendations).

Distribution of tower counts by hour indicates that most of the salmon passage occurred from 0000 to 0400, and from 1400 to 2400 (Figure 17). Peak chinook salmon hourly passage rates occurred in the early morning hours, while chum and pink salmon passage was highest in the late afternoon and evening. The initial counting schedule of two 6 hr shifts per day was modified to two 8 hr shifts per day on 5 July in order to improve the accuracy of the daily escapement estimates. The 1600-2400 period was counted each day since this was found to be a period of substantial salmon passage.

An aerial survey was flown of the East and West Fork Andreafsky River under fair conditions on 14 July. This was earlier than the optimal survey timing of 20 to 31 July, but heavy rainfall prohibited additional surveys later in the spawning period. A total of 83,931 chum salmon and 1,954 chinook salmon was enumerated above the tower site on the East Fork, and 99,373 chum salmon and 3,158 chinook salmon on the entire West Fork. The East Fork chum salmon count was 50% of the total season tower count estimate of 167,614 fish, while the chinook salmon aerial survey count was 28% greater than the incomplete tower count estimate of 1,530 fish.

The chum and chinook salmon aerial survey escapement objectives were achieved for each fork. Those objectives are 1,100 to 1,600 chinook salmon for the East Fork, 700 to 1,000 for the West Fork, and 76,000 to 109,000 summer chum salmon for the East Fork, 62,000 to 116,000 for the West Fork (ADF&G 1985). The East Fork chinook salmon survey count was the largest since 1981, while the West Fork count was the largest ever recorded.

Twenty-seven beach seine sets were made from 27 June to 15 July, and a total of 822 chum salmon, 16 chinook salmon, and 668 pink salmon was captured (Appendix Table 7). Additional chinook salmon samples were obtained by carcass survey of both the East and West Fork in August.

Of the 822 chum salmon sampled for age-sex-size data, 775 (94%) later proved to have ageable scales. Age composition was 61% age 4, 37% age 5, 1.7% age 6, and 0.3% age 3 (Appendix Table 8). Females accounted for 55% of the sample. Age 4 accounted for the majority of samples in 1982, 1984, and 1985, while age 5 was predominant in 1981 and 1983 (Figure 18). Age composition of the Andreafsky River escapement sample in 1986 differred from that of the commercial fishery catch and the Anvik River escapement in that age 5 was in the majority for the latter two samples. Sex composition was similar for the two escapement samples.

Of the 350 chinook salmon sampled for age-sex-size data, 275 (79%) later proved to have ageable scales. Age composition was 2% age 4, 70% age 5, 22% age 6, and 6% age 7 (Appendix Table 9). Females accounted for 23% of the sample. Ages 5 and 7 accounted

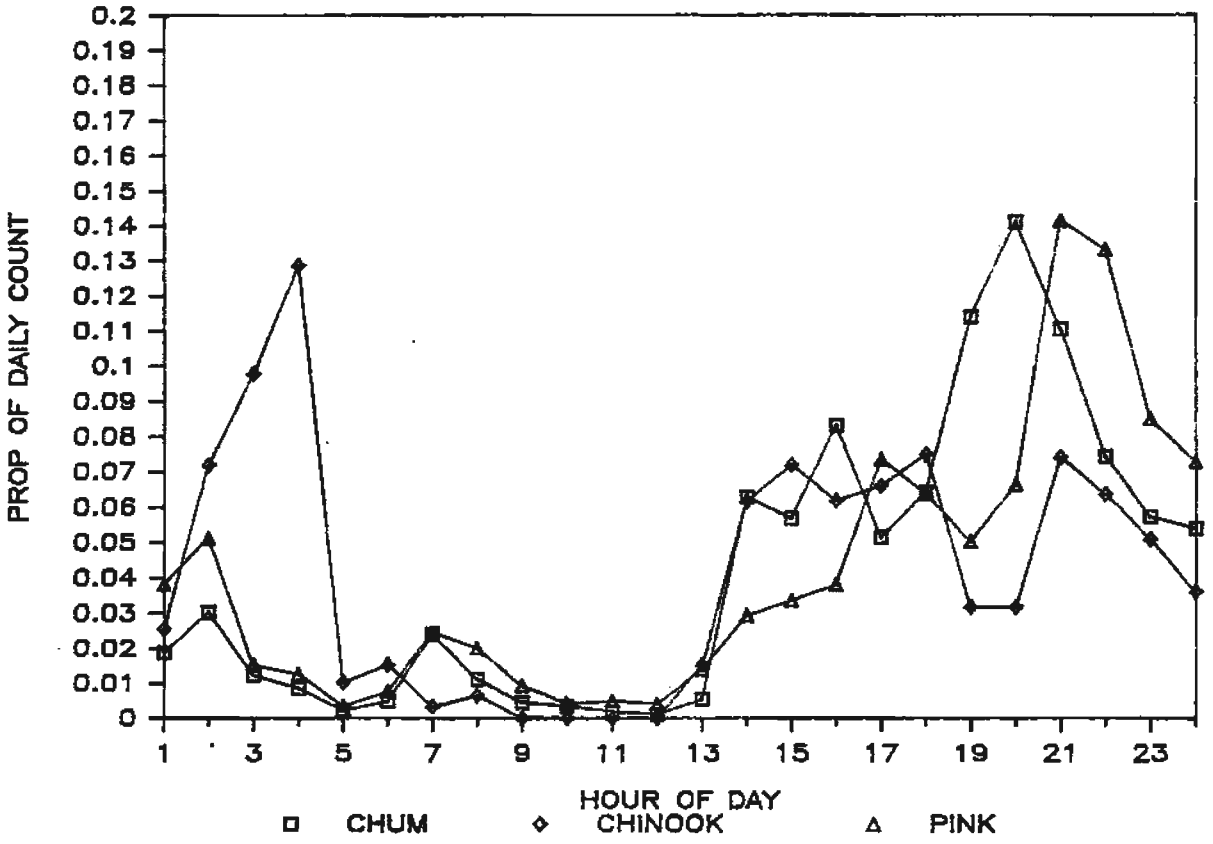


Figure 17. Distribution of summer chum, chinook, and pink salmon tower counts by hour of the day for the East Fork Anreafsky River, 1986.

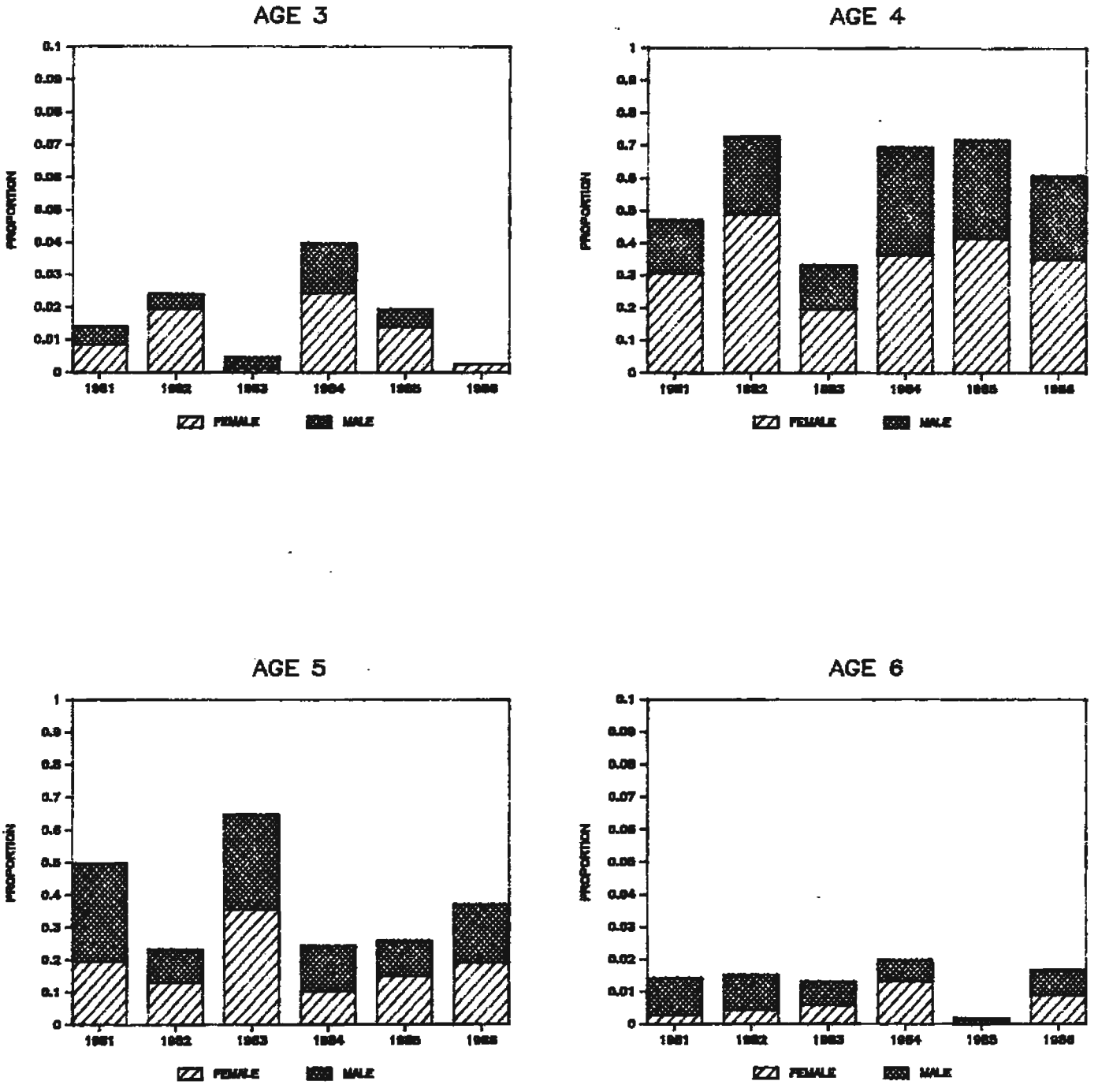


Figure 18. Age and sex composition of East Fork Andreafsky River summer chum salmon, 1981-1986, presented as proportion of total sample for each year by age class. Note different scale for ages 3 and 6.

for a relatively greater proportion of the sample in 1986, and ages 4 and 6 a relatively smaller proportion, than for most years since sampling was initiated in 1981 (Figure 19). This is similar to results for the commercial fishery samples (Buklis and Merritt, In Prep). The female component was in the lower end of the range compared to previous years, which is contrary to the composition of the Anvik River escapement sample in 1986. The large proportion of age 5 males in the sample, as well as the large proportion of age 6 males relative to age 6 females, may in part be a result of the crew actively searching backwater areas in the lower river for carcasses in addition to upriver spawning areas. Many of the males, which die off earlier than females and were carried far downriver in the high water conditions, were found in the lower river. The Anvik River crew, which concentrated survey effort only on the upriver spawning areas, found fewer males.

CONCLUSIONS AND RECOMMENDATIONS

Escapement to the Anvik River was estimated by side-scanning sonar to be 1,189,602 summer chum salmon in 1986, which is 2.4 times greater than the sonar count escapement objective of 487,000 fish. Escapement to the East Fork Andreafsky River was estimated by tower count to be 167,614 summer chum salmon, which is 32% greater than the 1981-1984 average sonar count. Chinook salmon escapement objectives were achieved in both systems. Pink salmon were abundant in the Andreafsky River, with an incomplete tower count in the East Fork of 124,618 fish.

There is no stock identification data available for the Yukon River summer chum salmon fisheries. Stock specific run timing through these fisheries is not known. However, if the Anvik River stock does move through the lower river districts relatively early, it may support only a moderate exploitation rate during the large mesh chinook salmon season. Conversely, if the East Fork Andreafsky River stock enters the Yukon River relatively late, it may sustain a significantly higher exploitation rate in the targeted chum salmon fishery. The introduction of special chum salmon fishing periods during the traditional chinook salmon season in the lower Yukon River in 1986 was an attempt to optimize exploitation of a strong early component of the summer chum salmon run. Yet escapement to the Anvik River in 1986 was still twofold the objective for the third consecutive year, and fourth out of the last six.

Summer chum salmon run timing at the lower Yukon River set gillnet test fishery (mile 20), at the Yukon River sonar site (mile 123), at the East Fork Andreafsky River tower site (mile 125), and at the Anvik River sonar site (mile 365) can be compared to provide a qualitative assessment of probable stock timing through the lower river fisheries (Figure 20). Given that the mean dates of passage at each of these four sites in 1986

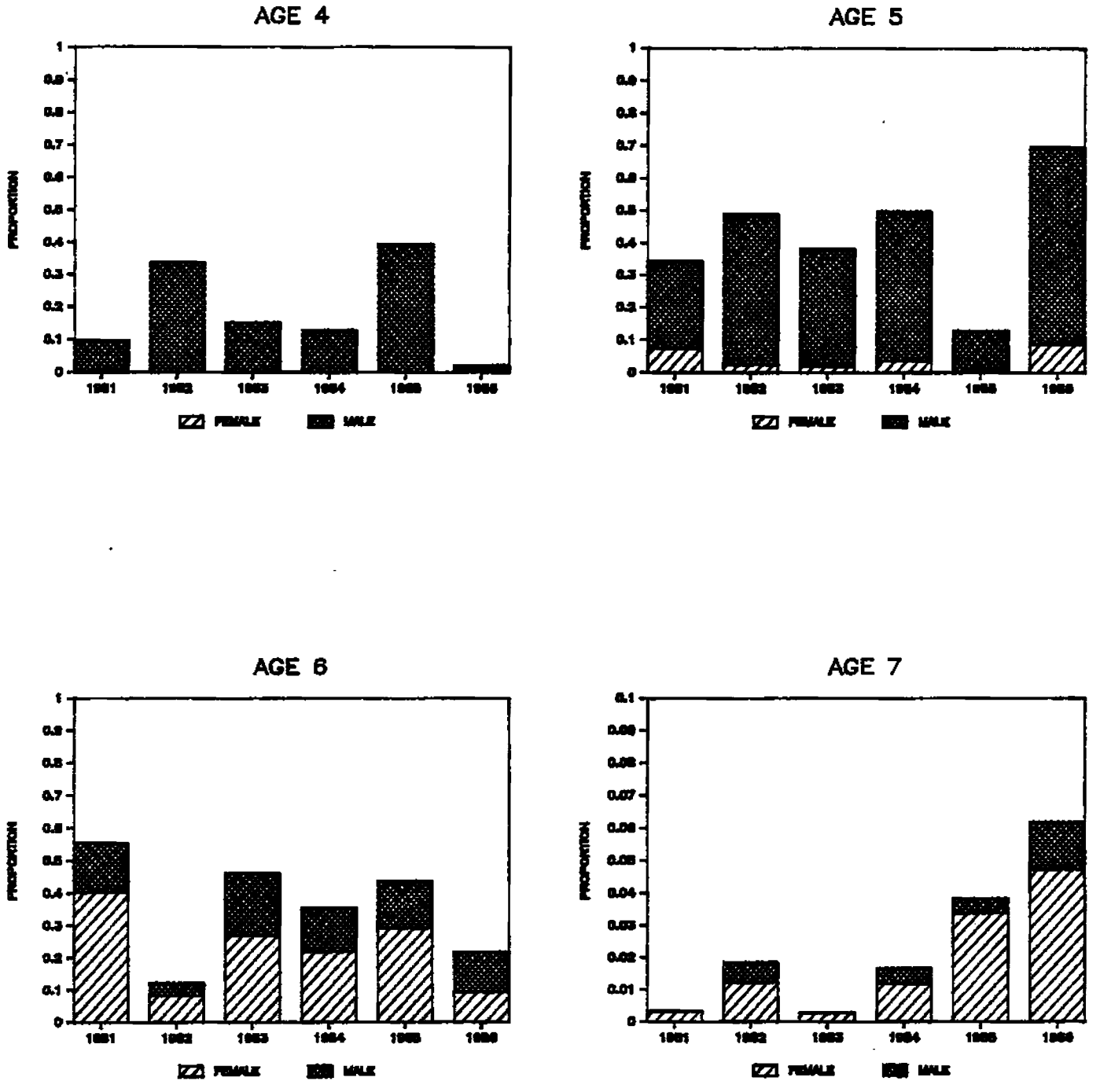


Figure 19. Age and sex composition of Andreafsky River chinook salmon, 1981-1986, presented as proportion of total sample for each year by age class. Note different scale for age 7.

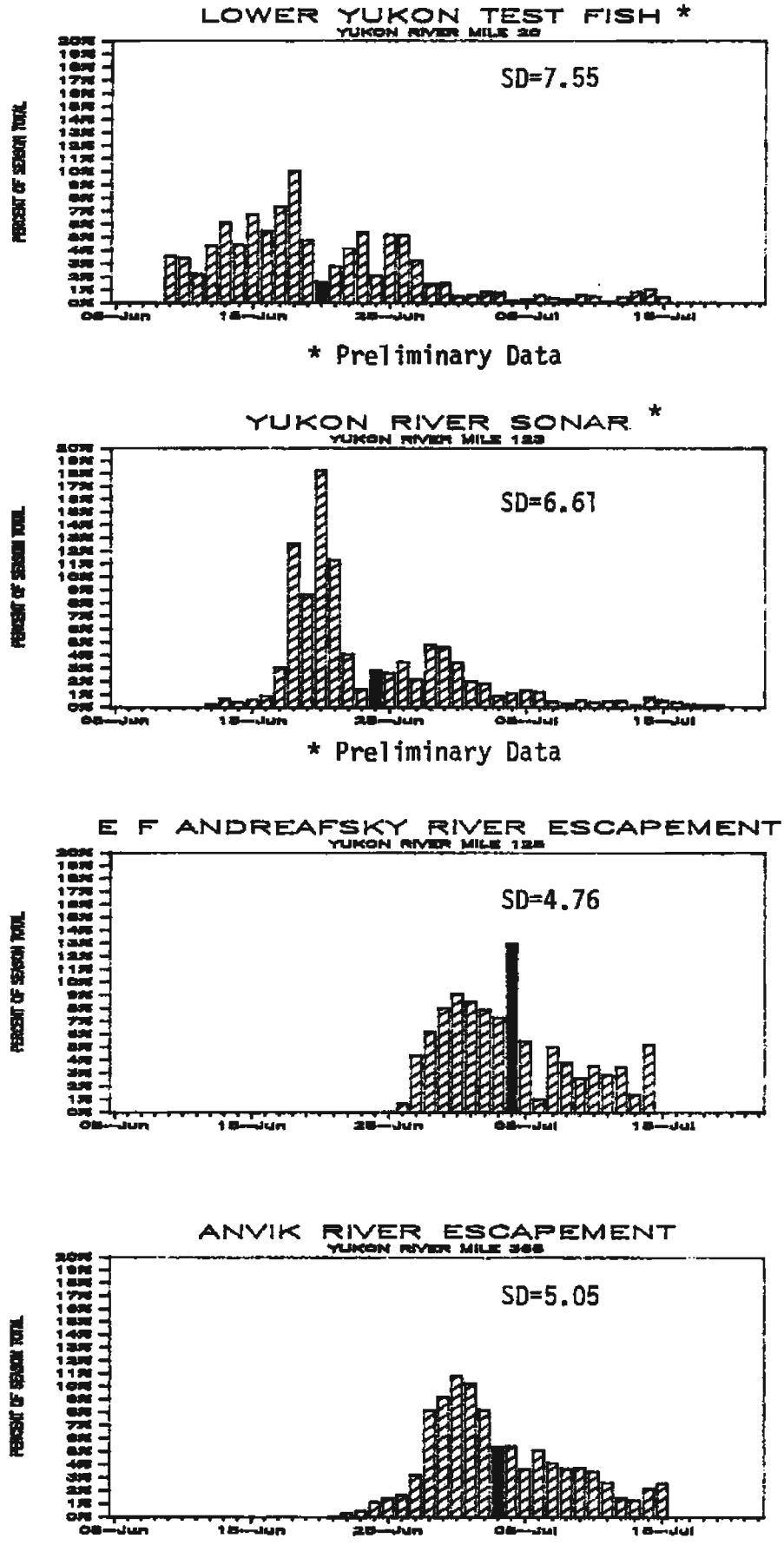


Figure 20. Run timing of Yukon River summer chum salmon in 1986 as indicated by catches, sonar counts, or tower counts at four sites. Mean date of run passage is indicated by shaded bar, and standard deviation (SD) of the mean is given.

was 20 June, 24 June, 4 July, and 3 July, respectively, it is probable that the Anvik River stock entered the Yukon River earlier than the Andreafsky River stock.

Comparing mean dates of passage and river miles between sites results in calculated swimming speeds of 25.8 miles per day between the test fishery and Yukon River sonar site, 26.5 miles per day between the test fishery and the Anvik River sonar site, and only 7.5 miles per day between the test fishery and the East Fork Andreafsky River tower site. Differential swimming speeds and milling behaviors by the two stocks are possible explanations, but later entry by the Andreafsky River stock seems more probable.

The new method of deploying sonar transducers on the Anvik River was effective in 1986. The method should perform well even in very high water conditions, as were encountered in 1985. A similar set of transducer deployment assemblies is available for use on the East Fork Andreafsky River if sonar is used to enumerate salmon escapement in that stream in the future.

Tower counting proved to be a feasible method of obtaining daily salmon escapement counts by species for the East Fork Andreafsky River in 1986. Low water and good clarity contributed to the success of the project. It is recommended that escapement to this system in 1987 be estimated by tower counting, with sonar equipment available in reserve in case of high water conditions. Accuracy of tower counts could be improved by:

(1) Count for 20 minutes out of each hour and expand by a factor of three, as opposed to 15 minute counts and expansions by a factor of four.

(2) Operate three 8 hr counting shifts each day using a three person crew, so that no daily expansion is necessary for missing blocks of time.

(3) If crew size is restricted to two persons due to funding limitations, optimize 8 hr counting shifts based on the hourly distribution of counts in 1986, and develop expansion factors for each species based on the 1986 results.

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Appendix Table 1. Anvik River salmon beach seine catch by species, sex, and date, 1986. a

Date	Number Of Sets	Chum			Chinook			Pink		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
22-Jun	1	0	0	0	0	0	0	0	0	0
23-Jun	2	1	0	1	0	0	0	0	0	0
24-Jun	1	0	3	3	0	0	0	0	0	0
25-Jun	1	0	0	0	0	0	0	0	0	0
26-Jun	5	12	13	25	0	0	0	0	0	0
27-Jun	3	0	2	2	0	0	0	0	0	0
28-Jun										
29-Jun	1	9	23	32	0	0	0	0	0	0
30-Jun	3	42	48	90	0	0	0	0	0	0
01-Jul	4	9	11	20	0	0	0	0	0	0
02-Jul	6	7	23	30	0	0	0	0	0	0
03-Jul										
04-Jul										
05-Jul	1	38	20	58	0	0	0	0	0	0
06-Jul	4	20	31	51	0	0	0	0	0	0
07-Jul	2	19	27	46	0	0	0	1	3	4
08-Jul										
09-Jul	3	25	34	59	0	1	1	1	0	1
10-Jul										
11-Jul	5	14	34	48	1	1	2	6	5	11
12-Jul										
13-Jul										
14-Jul	4	24	32	56	0	0	0	3	2	5
Totals	46	220	301	521	1	2	3	11	10	21

a All beach seining was conducted at a site on the west bank approximately 300 meters upstream from the sonar site.

Appendix Table 2. Age and sex composition of Anvik River summer chum salmon escapement samples, 1972-1986. a

NUMBERS OF FISH

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 31 MALE	AGE 31 FEMALE	AGE 31 TOTAL	AGE 41 MALE	AGE 41 FEMALE	AGE 41 TOTAL	AGE 51 MALE	AGE 51 FEMALE	AGE 51 TOTAL	AGE 61 MALE	AGE 61 FEMALE	AGE 61 TOTAL
1972	167	153	320	0	0	0	25	37	62	138	115	253	4	1	5
1973	265	518	783	11	37	48	204	401	605	49	79	128	1	1	2
1974	245	157	402	12	24	36	197	120	317	34	12	46	2	1	3
1975	270	314	584	4	17	21	253	288	541	13	9	22	0	0	0
1976	281	320	601	5	4	9	43	35	78	233	281	514	0	0	0
1977	191	398	589	20	111	131	161	270	431	7	15	22	3	2	5
1978	289	263	552	0	1	1	210	180	390	79	82	161	0	0	0
1979	273	306	579	2	12	14	154	193	347	115	99	214	2	2	4
1980	167	258	425	0	1	1	147	226	373	20	31	51	0	0	0
1981	151	182	333	0	0	0	49	67	116	99	115	214	3	0	3
1982	117	265	382	4	17	21	75	181	256	37	65	102	1	2	3
1983	183	238	421	0	4	4	99	142	241	83	90	173	1	2	3
1984	138	215	353	2	6	8	117	189	306	19	20	39	0	0	0
1985	233	294	527	0	11	11	172	225	397	59	58	117	2	0	2
1986	205	281	486	0	2	2	59	89	148	143	186	329	3	4	7

PERCENT OF TOTAL SAMPLE b

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 31 MALE	AGE 31 FEMALE	AGE 31 TOTAL	AGE 41 MALE	AGE 41 FEMALE	AGE 41 TOTAL	AGE 51 MALE	AGE 51 FEMALE	AGE 51 TOTAL	AGE 61 MALE	AGE 61 FEMALE	AGE 61 TOTAL
1972	52.19%	47.81%	100.00%	0.00%	0.00%	0.00%	7.81%	11.56%	19.38%	43.13%	35.94%	79.06%	1.25%	0.31%	1.56%
1973	33.84%	66.16%	100.00%	1.40%	4.73%	6.13%	26.05%	51.21%	77.27%	6.26%	10.09%	16.35%	0.13%	0.13%	0.26%
1974	60.95%	39.05%	100.00%	2.99%	5.97%	8.96%	49.00%	29.85%	78.86%	8.46%	2.99%	11.44%	0.50%	0.25%	0.75%
1975	46.23%	53.77%	100.00%	0.68%	2.91%	3.60%	43.32%	49.32%	92.64%	2.23%	1.54%	3.77%	0.00%	0.00%	0.00%
1976	46.76%	53.24%	100.00%	0.83%	0.67%	1.50%	7.15%	5.82%	12.98%	38.77%	46.76%	85.52%	0.00%	0.00%	0.00%
1977	32.43%	67.57%	100.00%	3.40%	18.85%	22.24%	27.33%	45.84%	73.17%	1.19%	2.55%	3.74%	0.51%	0.34%	0.85%
1978	52.36%	47.64%	100.00%	0.00%	0.18%	0.18%	38.04%	32.61%	70.65%	14.31%	14.86%	29.17%	0.00%	0.00%	0.00%
1979	47.15%	52.85%	100.00%	0.35%	2.07%	2.42%	26.60%	33.33%	59.93%	19.86%	17.10%	36.96%	0.35%	0.35%	0.69%
1980	39.29%	60.71%	100.00%	0.00%	0.24%	0.24%	34.59%	53.18%	87.76%	4.71%	7.29%	12.00%	0.00%	0.00%	0.00%
1981	45.35%	54.65%	100.00%	0.00%	0.00%	0.00%	14.71%	20.12%	34.83%	29.73%	34.53%	64.26%	0.90%	0.00%	0.90%
1982	30.63%	69.37%	100.00%	1.05%	4.45%	5.50%	19.63%	47.38%	67.02%	9.69%	17.02%	26.70%	0.26%	0.52%	0.79%
1983	43.47%	56.53%	100.00%	0.00%	0.95%	0.95%	23.52%	33.73%	57.24%	19.71%	21.38%	41.09%	0.24%	0.48%	0.71%
1984	39.09%	60.91%	100.00%	0.57%	1.70%	2.27%	33.14%	53.54%	86.69%	5.38%	5.67%	11.05%	0.00%	0.00%	0.00%
1985	44.21%	55.79%	100.00%	0.00%	2.09%	2.09%	32.64%	42.69%	75.33%	11.20%	11.01%	22.20%	0.38%	0.00%	0.38%
1986	42.18%	57.82%	100.00%	0.00%	0.41%	0.41%	12.14%	18.31%	30.45%	29.42%	38.27%	67.70%	0.62%	0.82%	1.44%

a Samples collected by carcass survey 1972-1981, by beach seine 1983-1986, and by both methods combined in 1982.
b Sample percentages not weighted by time period or escapement counts.

Appendix Table 3. Age and sex composition of Awik River chinook salmon escapement samples, 1972-1986. a

NUMBERS OF FISH

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 4 MALE	AGE 4 FEMALE	AGE 4 TOTAL	AGE 5 MALE	AGE 5 FEMALE	AGE 5 TOTAL	AGE 6 MALE	AGE 6 FEMALE	AGE 6 TOTAL	AGE 7 MALE	AGE 7 FEMALE	AGE 7 TOTAL
1972	10	5	15	0	0	0	8	0	8	2	5	7	0	0	0
1973	6	4	10	1	0	1	0	0	0	5	3	8	0	1	1
1974	NO SAMPLES COLLECTED														
1975	6	2	8	1	0	1	4	1	5	1	1	2	0	0	0
1976	33	12	45	6	0	6	25	5	30	2	7	9	0	0	0
1977	58	59	117	2	1	3	27	6	33	27	48	75	2	4	6
1978	36	41	77	13	0	13	10	1	11	13	39	52	0	1	1
1979	37	9	46	17	0	17	14	0	14	6	6	12	0	3	3
1980	41	42	83	19	1	20	21	22	43	1	16	17	0	3	3
1981	109	154	263	33	1	34	61	36	97	15	116	131	0	1	1
1982	100	38	138	47	1	48	47	5	52	6	32	38	0	0	0
1983	173	133	306	56 b	0	56	84	26	110	33	104	137	0	3	3
1984	162	114	276	29	4	33	108	30	138	25	74	99	0	6	6
1985	25	8	33	10	0	10	10	3	13	5	5	10	0	0	0
1986	53	89	142	0	1	1	44	27	71	6	48	54	3	13	16

PERCENT OF TOTAL SAMPLE c

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 4 MALE	AGE 4 FEMALE	AGE 4 TOTAL	AGE 5 MALE	AGE 5 FEMALE	AGE 5 TOTAL	AGE 6 MALE	AGE 6 FEMALE	AGE 6 TOTAL	AGE 7 MALE	AGE 7 FEMALE	AGE 7 TOTAL
1972	66.67%	33.33%	100.00%	0.00%	0.00%	0.00%	53.33%	0.00%	53.33%	13.33%	33.33%	46.67%	0.00%	0.00%	0.00%
1973	60.00%	40.00%	100.00%	10.00%	0.00%	10.00%	0.00%	0.00%	0.00%	50.00%	30.00%	80.00%	0.00%	10.00%	10.00%
1974	NO SAMPLES COLLECTED														
1975	75.00%	25.00%	100.00%	12.50%	0.00%	12.50%	50.00%	12.50%	62.50%	12.50%	12.50%	25.00%	0.00%	0.00%	0.00%
1976	73.33%	26.67%	100.00%	13.33%	0.00%	13.33%	55.56%	11.11%	66.67%	4.44%	15.56%	20.00%	0.00%	0.00%	0.00%
1977	49.57%	50.43%	100.00%	1.71%	0.85%	2.56%	23.08%	5.13%	28.21%	23.08%	41.03%	64.10%	1.71%	3.42%	5.13%
1978	46.75%	53.25%	100.00%	16.88%	0.00%	16.88%	12.99%	1.30%	14.29%	16.88%	50.65%	67.53%	0.00%	1.30%	1.30%
1979	80.43%	19.57%	100.00%	36.96%	0.00%	36.96%	30.43%	0.00%	30.43%	13.04%	13.04%	26.09%	0.00%	6.52%	6.52%
1980	49.40%	50.60%	100.00%	22.89%	1.20%	24.10%	25.30%	26.51%	51.81%	1.20%	19.28%	20.48%	0.00%	3.61%	3.61%
1981	41.44%	58.56%	100.00%	12.55%	0.38%	12.93%	23.19%	13.69%	36.88%	5.70%	44.11%	49.81%	0.00%	0.38%	0.38%
1982	72.46%	27.54%	100.00%	34.06%	0.72%	34.78%	34.06%	3.62%	37.68%	4.35%	23.19%	27.54%	0.00%	0.00%	0.00%
1983	56.54%	43.46%	100.00%	18.30%	0.00%	18.30%	27.45%	8.50%	35.95%	10.78%	33.99%	44.77%	0.00%	0.98%	0.98%
1984	58.70%	41.30%	100.00%	10.51%	1.45%	11.96%	39.13%	10.87%	50.00%	9.06%	26.81%	35.87%	0.00%	2.17%	2.17%
1985	75.76%	24.24%	100.00%	30.30%	0.00%	30.30%	30.30%	9.09%	39.39%	15.15%	15.15%	30.30%	0.00%	0.00%	0.00%
1986	37.32%	62.68%	100.00%	0.00%	0.70%	0.70%	30.99%	19.01%	50.00%	4.23%	33.80%	38.03%	2.11%	9.15%	11.27%

a Samples collected by carcass survey each year, with a very few fish also taken by beach seine or hook and line in some years.
b Includes one age 3 male.
c Sample percentages not weighted by time period or escapement counts.

Appendix Table 4. East Fork Andreafsky River summer chum salmon tower counts by hour and date, 1986, with count estimation formulas derived from these data for missing time blocks.

	EXPANDED HOURLY COUNT (4X ACTUAL 15 MINUTE COUNT) FOR HOUR ENDING:																							
DATE	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	TOTAL
25-Jun							16	0	20	4	8	0							0	0	-12	4	4	44	88
26-Jun							0	0	0	4	0	4							0	24	0	116	172	312	632
27-Jun							40	48	36	0	20	4							376	648	524	776	1,020	476	3,968
28-Jun							764	264	80	52	20	16							656	1,216	796	868	732	556	6,020
29-Jun							116	36	16	16	0	16							1,976	3,284	364	216	676	500	7,216
30-Jun							96	84	48	52	12	8							1,860	3,340	1,076	472	820	352	8,220
01-Jul																									0
02-Jul	104	176	152	16	28	8							20	52	340	168	108	304							1,476
03-Jul	56	36	8	20	8	64							44	48	36	64	188	2,276	3,216	2,020	1,752	64	184	460	10,544
04-Jul													68	3,068	2,392	3,736	1,700	784	3,016	2,704	284	304	124	376	18,576
05-Jul	256	320	120	36	32	40	24	28									436	356	1,444	1,516	1,084	1,144	208	476	7,520
06-Jul									12	8	12	16	8	4	52	72	16	0	8	296	300	288	132	128	1,352
07-Jul	24	156	56	60	28	28	548	108									92	80	56	120	3,080	1,784	456	256	6,932
08-Jul																									0
09-Jul									16	16	8	20	80	28	40	40	152	68	260	640	1,516	208	220	188	3,500
10-Jul	168	188	164	128	8	16	296	220									152	180	332	512	936	1,084	444	168	4,996
11-Jul									80	88	20	0	12	40	24	24	40	88	176	32	288	208	1,100	1,556	3,776
12-Jul	308	616	60	88	4	8	28	72									720	560	356	364	612	568	244	272	4,880
13-Jul									24	12	32	8	32	36	80	232	272	236	132	84	124	156	160	232	1,852
14-Jul	72	92	88	96	12	96	52	56									720	808	536	1,076	1,256	1,152	548	484	7,164
TOTAL	988	1,584	648	444	180	260	1,980	916	332	252	132	92	284	3,276	2,964	4,336	4,596	5,740	14,420	17,876	13,980	9,412	7,244	6,836	98,712

Time blocks are defined as follows: 1 = 0000-0600 2 = 0600-1200 3 = 1200-1800 4= 1800-2400
A = 0000-0800 B = 0800-1600 C = 1600-2400

Estimation formulas for missing time blocks and the count data used to determine these formulas are as follows:

Expansion Formula	Data Source For Relationship Between Time Blocks
Block 1=(Block 4/0.8948)-(Block 4)	7/03 7/05 7/07 7/10 7/12 7/14
Block 2=(Block 4/0.9273)-(Block 4)	6/25 6/26 6/27 6/28 6/29 6/30
Block 3=(Block 4/0.6228)-(Block 4)	7/03 7/04 7/06 7/09 7/11 7/13
Block A=(Block C/0.8476)-(Block C)	7/05 7/07 7/10 7/12 7/14
Block B=(Block C/0.8878)-(Block C)	7/06 7/09 7/11 7/13

Appendix Table 5. East Fork Andreafsky River chinook salmon tower counts by hour and date, 1986, with count estimation formulas derived from these data for missing time blocks.

	EXPANDED HOURLY COUNT (4X ACTUAL 15 MINUTE COUNT) FOR HOUR ENDING:																							
DATE	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	TOTAL
25-Jun							0	0	0	0	0	0							0	0	0	0	0	0	0
26-Jun							0	0	0	0	0	0							0	0	0	0	0	0	0
27-Jun							0	0	0	0	0	0							0	0	0	0	0	0	0
28-Jun							0	0	0	0	0	0							0	0	0	0	0	0	0
29-Jun							0	0	0	0	0	0							0	0	0	0	0	0	0
30-Jun							0	0	0	0	0	-4							0	0	0	0	0	0	-4
01-Jul																									0
02-Jul	0	0	0	0	0	0							0	0	0	4	0	8							12
03-Jul	0	0	0	4	0	0							4	8	12	12	0	32	0	0	4	0	0	4	80
04-Jul													4	40	44	20	24	0	20	20	0	0	0	8	180
05-Jul	0	8	24	16	4	4	4	0									20	28	12	12	64	28	12	12	248
06-Jul									0	0	0	0	4	0	0	8	0	0	0	8	8	8	0	0	36
07-Jul	0	0	8	44	4	4	0	8									0	0	0	0	28	24	16	12	148
08-Jul																									0
09-Jul									0	0	0	0	0	0	0	0	4	0	4	4	8	8	8	8	44
10-Jul	4	8	0	4	0	4	0	0									8	8	0	0	4	32	16	4	92
11-Jul									0	0	0	0	0	0	0	0	0	4	4	0	0	0	8	12	28
12-Jul	16	36	12	8	0	0	0	0									12	8	8	4	0	8	8	4	124
13-Jul									0	0	0	0	0	0	0	4	4	4	0	0	0	0	4	0	16
14-Jul	0	4	32	24	0	0	0	0									16	8	12	12	24	12	24	4	172
TOTAL	20	56	76	100	8	12	4	8	0	0	0	-4	12	48	56	48	88	100	60	60	140	120	96	68	1,176

Time blocks are defined as follows: 1 = 0000-0600 2 = 0600-1200 3 = 1200-1800 4= 1800-2400
A = 0000-0800 B = 0800-1600 C = 1600-2400

Estimation formulas for missing time blocks and the count data used to derive these formulas are as follows:

Expansion Formula	Data Source For Relationship Between Time Blocks
Block 1=(Block 4/0.5976)-(Block 4)	7/03 7/05 7/07 7/10 7/12 7/14
Block 2= Insufficient Count Data	6/25 6/26 6/27 6/28 6/29 6/30
Block 3=(Block 4/0.3955)-(Block 4)	7/03 7/04 7/06 7/09 7/11 7/13
Block A=(Block C/0.6429)-(Block C)	7/05 7/07 7/10 7/12 7/14
Block B=(Block C/0.8710)-(Block C)	7/06 7/09 7/11 7/13

Appendix Table 6. East Fork Andreafsky River pink salmon tower counts by hour and date, 1986, with count estimation formulas derived from these data for missing time blocks.

	EXPANDED HOURLY COUNT (4X ACTUAL 15 MINUTE COUNT) FOR HOUR ENDING:																							
DATE	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	TOTAL
25-Jun							0	0	0	0	0	0							0	0	0	0	0	0	0
26-Jun							0	0	0	0	0	0							0	0	0	0	0	0	0
27-Jun							0	0	0	0	0	0							0	4	0	0	0	0	4
28-Jun							8	0	0	4	4	0							0	4	4	0	4	0	28
29-Jun							0	8	0	0	0	0							20	20	0	0	0	0	48
30-Jun							4	0	4	0	4	0							32	24	0	8	40	16	132
01-Jul																									0
02-Jul	8	24	32	0	0	0							0	0	8	0	0	12							84
03-Jul	16	32	32	16	8	80							4	0	12	40	28	348	244	216	156	0	316	312	1,860
04-Jul													200	912	1,004	920	1,112	436	744	956	160	200	316	628	7,588
05-Jul	264	376	184	168	0	20	0	88									420	292	576	668	1,228	996	364	616	6,260
06-Jul									16	0	4	88	72	16	72	140	100	0	24	488	760	988	388	500	3,656
07-Jul	60	244	68	56	36	72	780	416									140	120	24	188	4,072	3,912	1,496	852	12,536
08-Jul																									0
09-Jul									36	44	28	36	204	232	44	56	180	88	208	664	2,036	904	800	668	6,228
10-Jul	544	492	216	192	20	48	440	420									876	540	880	1,184	1,960	2,536	1,584	352	12,284
11-Jul									484	200	208	16	52	116	100	92	88	144	296	336	580	640	1,452	1,548	6,352
12-Jul	708	976	92	88	8	12	156	236									1,148	928	764	424	1,876	1,392	612	744	10,164
13-Jul									120	64	112	152	160	180	424	640	520	924	576	628	504	560	592	604	6,760
14-Jul	300	400	136	108	104	152	532	392									1,616	1,596	1,652	2,160	3,664	3,860	2,244	1,908	20,824
TOTAL	1,900	2,544	760	528	176	384	1,920	1,560	660	312	360	292	692	1,456	1,664	1,888	6,228	5,428	6,040	7,964	17,000	15,996	10,208	8,748	94,808

Time blocks are defined as follows: 1 = 0000-0600 2 = 0600-1200 3 = 1200-1800 4= 1800-2400
A = 0000-0800 B = 0800-1600 C = 1600-2400

Estimation formulas for missing time blocks and the count data used to determine these formulas are as follows:

Expansion Formula	Data Source For Relationship Between Time Blocks
Block 1=(Block 4/0.8791)-(Block 4)	7/03 7/05 7/07 7/10 7/12 7/14
Block 2=(Block 4/0.8302)-(Block 4)	6/25 6/26 6/27 6/28 6/29 6/30
Block 3=(Block 4/0.6848)-(Block 4)	7/03 7/04 7/06 7/09 7/11 7/13
Block A=(Block C/0.8453)-(Block C)	7/05 7/07 7/10 7/12 7/14
Block B=(Block C/0.8170)-(Block C)	7/06 7/09 7/11 7/13

Appendix Table 7. East Fork Andreafsky River salmon beach seine catch by species, sex, and date, 1986. a

Date	Number Of Sets	Chum			Chinook			Pink		
		Male	Female	Total	Male	Female	Total	Male	Female	Total
27-Jun	2	23	20	43						
28-Jun	1	20	23	43						
29-Jun	2	25	27	52				1	0	1
30-Jun	3	19	12	31						
01-Jul	2	17	24	41	2	1	3	2	0	2
02-Jul	1	40	22	62				5	2	7
03-Jul	1	47	33	80	2	0	2	27	12	39
04-Jul	4	36	26	62				31	8	39
05-Jul	2	14	34	48				12	9	21
06-Jul										
07-Jul	1	33	41	74				17	6	23
08-Jul										
09-Jul	1	21	30	51				57	19	76
10-Jul	2	16	21	37	5	0	5	29	12	41
11-Jul	1	22	39	61	3	3	6	41	19	60
12-Jul										
13-Jul	1	17	54	71				138	96	234
14-Jul	1	11	20	31				34	33	67
15-Jul	2	14	21	35				31	27	58
Totals	27	375	447	822	12	4	16	425	243	668

a Beach seining was conducted at a site located approximately 1/8 mile below the tower site. Not included in the catch totals are 59 chum salmon that escaped from the seine or holding pen.

Appendix Table B. Age and sex composition of East Fork Andreafsky River summer chum salmon escapement samples, 1981-1986. a

NUMBERS OF FISH

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 31 MALE	AGE 31 FEMALE	AGE 31 TOTAL	AGE 41 MALE	AGE 41 FEMALE	AGE 41 TOTAL	AGE 51 MALE	AGE 51 FEMALE	AGE 51 TOTAL	AGE 61 MALE	AGE 61 FEMALE	AGE 61 TOTAL
1981	170	181	351	2	3	5	58	108	166	106	69	175	4	1	5
1982	161	295	456	2	9	11	108	224	332	46	60	106	5	2	7
1983	366	468	834	3	1	4	114	164	278	243	298	541	6	5	11
1984	222	229	451	7	11	18	149	165	314	63	47	110	3	6	9
1985	237	329	566	3	8	11	172	235	407	61	86	147	1	0	1
1986	346	429	775	0	2	2	200	272	472	140	148	288	6	7	13

PERCENT OF TOTAL SAMPLE b

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 31 MALE	AGE 31 FEMALE	AGE 31 TOTAL	AGE 41 MALE	AGE 41 FEMALE	AGE 41 TOTAL	AGE 51 MALE	AGE 51 FEMALE	AGE 51 TOTAL	AGE 61 MALE	AGE 61 FEMALE	AGE 61 TOTAL
1981	48.43%	51.57%	100.00%	0.57%	0.85%	1.42%	16.52%	30.77%	47.29%	30.20%	19.66%	49.86%	1.14%	0.28%	1.42%
1982	35.31%	64.69%	100.00%	0.44%	1.97%	2.41%	23.68%	49.12%	72.81%	10.09%	13.16%	23.25%	1.10%	0.44%	1.54%
1983	43.88%	56.12%	100.00%	0.36%	0.12%	0.48%	13.67%	19.66%	33.33%	29.14%	35.73%	64.87%	0.72%	0.60%	1.32%
1984	49.22%	50.78%	100.00%	1.55%	2.44%	3.99%	33.04%	36.59%	69.62%	13.97%	10.42%	24.39%	0.67%	1.33%	2.00%
1985	41.87%	58.13%	100.00%	0.53%	1.41%	1.94%	30.39%	41.52%	71.91%	10.78%	15.19%	25.97%	0.18%	0.00%	0.18%
1986	44.65%	55.35%	100.00%	0.00%	0.26%	0.26%	25.81%	35.10%	60.90%	18.06%	19.10%	37.16%	0.77%	0.90%	1.68%

a Samples collected by carcass survey in 1981, by beach seine in 1983 and 1986, and by both methods combined in 1982, 1984, and 1985.
b Sample percentages not weighted by time period or escapement counts.

Appendix Table 9. Age and sex composition of Andreafsky River chinook salmon escapement samples, 1981-1986. a

NUMBERS OF FISH

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 4 MALE	AGE 4 FEMALE	AGE 4 TOTAL	AGE 5 MALE	AGE 5 FEMALE	AGE 5 TOTAL	AGE 6 MALE	AGE 6 FEMALE	AGE 6 TOTAL	AGE 7 MALE	AGE 7 FEMALE	AGE 7 TOTAL
1981	154	143	297	29	0	29	80	22	102	45	120	165	0	1	1
1982	276	49	325	110 b	10	110	151	8	159	13	27	40	2	4	6
1983	251	104	355	54	0	54	129	7	136	68	96	164	0	1	1
1984	307	112	419	54 c	0	54	194	15	209	57	92	149	2	5	7
1985	296	147	443	175	0	173	55	2	57	64	130	194	2	15	17
1986	211	64	275	5	1	6	168	24	192	34	26	60	4	13	17

PERCENT OF TOTAL SAMPLE d

YEAR	SAMPLE MALE	SAMPLE FEMALE	SAMPLE TOTAL	AGE 4 MALE	AGE 4 FEMALE	AGE 4 TOTAL	AGE 5 MALE	AGE 5 FEMALE	AGE 5 TOTAL	AGE 6 MALE	AGE 6 FEMALE	AGE 6 TOTAL	AGE 7 MALE	AGE 7 FEMALE	AGE 7 TOTAL
1981	51.85%	48.15%	100.00%	9.76%	0.00%	9.76%	26.94%	7.41%	34.34%	15.15%	40.40%	55.56%	0.00%	0.34%	0.34%
1982	84.92%	15.08%	100.00%	33.85%	0.00%	33.85%	46.46%	2.46%	48.92%	4.00%	8.31%	12.31%	0.62%	1.23%	1.85%
1983	70.70%	29.30%	100.00%	15.21%	0.00%	15.21%	36.34%	1.97%	38.31%	19.15%	27.04%	46.20%	0.00%	0.28%	0.28%
1984	73.27%	26.73%	100.00%	12.89%	0.00%	12.89%	46.30%	3.58%	49.88%	13.60%	21.96%	35.56%	0.48%	1.19%	1.67%
1985	66.82%	33.18%	100.00%	39.50%	0.00%	39.50%	12.42%	0.45%	12.87%	14.45%	29.35%	43.79%	0.45%	3.39%	3.84%
1986	76.73%	23.27%	100.00%	1.82%	0.36%	2.18%	61.09%	8.73%	69.82%	12.36%	9.45%	21.82%	1.45%	4.73%	6.18%

a Samples collected by carcass survey of the East Fork and West Fork each year, with additional samples collected by beach seine from the East Fork for the years 1982 through 1986.

b Includes 7 age 3 males.

c Includes 1 age 3 male.

d Sample percentages not weighted by time period or escapement counts.